Xentra 4100
Gas Purity Analyser
Service Manual

Ref: 04100/002B/2
Order as part 04100002B

NOTES

HAZARD WARNINGS	
1.	LETHAL VOLTAGES: THE ELECTRICAL POWER USED IN THIS EQUIPMENT IS AT A VOLTAGE HIGH ENOUGH TO ENDANGER LIFE.
2.	BEFORE CARRYING OUT SERVICING OR REPAIR THE EQUIPMENT MUST BE DISCONNECTED FROM THE ELECTRICAL SUPPLY. TESTS MUST BE MADE TO ENSURE THAT DISCONNECTION IS COMPLETE.
3.	IF FOR ANY REASON THE POWER SUPPLY CANNOT BE DISCONNECTED, FUNCTIONAL TESTING, MAINTENANCE AND REPAIR OF THE ELECTRICAL UNITS IS ONLY TO BE UNDERTAKEN AS A LAST RESORT AND MUST BE CARRIED OUT BY PERSONS FULLY AWARE OF THE DANGER INVOLVED.

WARNINGS, CAUTIONS AND NOTES

**This publication includes WARNINGS, CAUTIONS AND NOTES which provide,
where appropriate, information relating to the following:**

WARNINGS	**:**	**Hazards which will result in personal injury or death.**
CAUTIONS	**:**	**Hazards which will result in equipment or property damage.**
NOTES	**:**	**Alert the user to pertinent facts and conditions.**

NOTICE: This service manual for the 4100 Gas Purity Analyser covers disassembly procedures for this equipment, and brief technical descriptions of component parts of the equipment. It should be thoroughly read and retained by the service engineer.

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SECTION 1: INTRODUCTION

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1 INTRODUCTION

1.1 Introduction

This manual contains essential information regarding servicing of the Servomex Xentra 4102 and 4104 Gas Purity Analysers.

This service manual is intended for use by Servomex trained service personnel. The manual contains technical descriptions, fault diagnosis information, part removal, refitting and test instructions as well as electrical and mechanical drawings and illustrations.

Repairs to PCB's are effected by board replacement. Component replacement is not recommended. The only exception to this is the display lamp Invertor mounted on the keypad.

WARNING

The user should note that the Xentra 4100 instrument contains no user serviceable parts inside. The instrument enclosure protects the user from electric shock and other hazards. All servicing should be referred to qualified service personnel.

1.2 General description

The Servomex Xentra chassis is a platform into which gas sensor modules may be fitted to make precise measurements.

Up to four modular gas sensors, for a wide range of gases and concentration levels selected according to the customer's needs, reside in the Xentra chassis. The Xentra chassis provides power, gas connections and other support functions to the gas sensor modules and receives their outputs from which it calculates sample gas concentrations. The calculated gas concentrations then may be displayed on the LCD display screen, directed to the analogue outputs and/or directed to the serial RS232 output.

The Xentra chassis also supports two external analogue input signals. These inputs may be used to combine the data from external transducers with the internal transducer data. The data from the external inputs may be displayed on the screen, output to the analogue outputs and/or output via the serial RS232 output.

The Xentra 4100 is designed for use in modern industrial and laboratory environments with emphasis on durable, rugged construction, low cost of ownership, reliable performance, simple operation and ease of service.

The analyser is controlled using an on-board microprocessor which gives the flexibility to configure the analyser to suit a wide range of applications.

The Xentra is operated via simple keypad controls mounted on the front facia of the analyser. Adjacent to the keypad is a large, Liquid crystal display (LCD), on which are displayed measurement values, alarms and other data.

A number of optional features are available for the Xentra 4100. These include the following:-

- A sample filter to protect the paramagnetic gas sensor modules from particulate contamination.
- An Autocalibration facility to allow the transducers to be calibrated without user intervention.
- Additional signal output cards to extend the number of analogue outputs and relay outputs available to the user.

A full technical specification for the 4100 Gas Purity Analyser is presented in both the Technical Data Sheet and the QuickStart manual, available from your local Servomex Company, agent, or representative.

1.3 Location of components

Figure 1.1 identifies the location of the key features of the Xentra 4100 Gas Purity Analyser.

1.4 Introduction to the Xentra user interface

The Xentra user interface consists of a keypad with nine keys and a large edge-lit LCD display (see Figure 1.1). During normal use of the instrument the LCD screen will display either the default measurement display or a menu based screen editor display. Toggling between the measurement display and the menu based editor is via the keypad. User input to the menu based screen editor is also via the keypad.

1.4.1 The Xentra measurement display

The measurement display is the default display that is presented to the user of the Xentra 4100. The display can be user configured to show the gas concentrations measured by the gas sensor modules fitted. The status of the instrument plus the occurrence of an alarm or fault active are also displayed on the measurement display via icons positioned at the bottom of the screen. The contents of the measurement display are shown in figure 1.2.

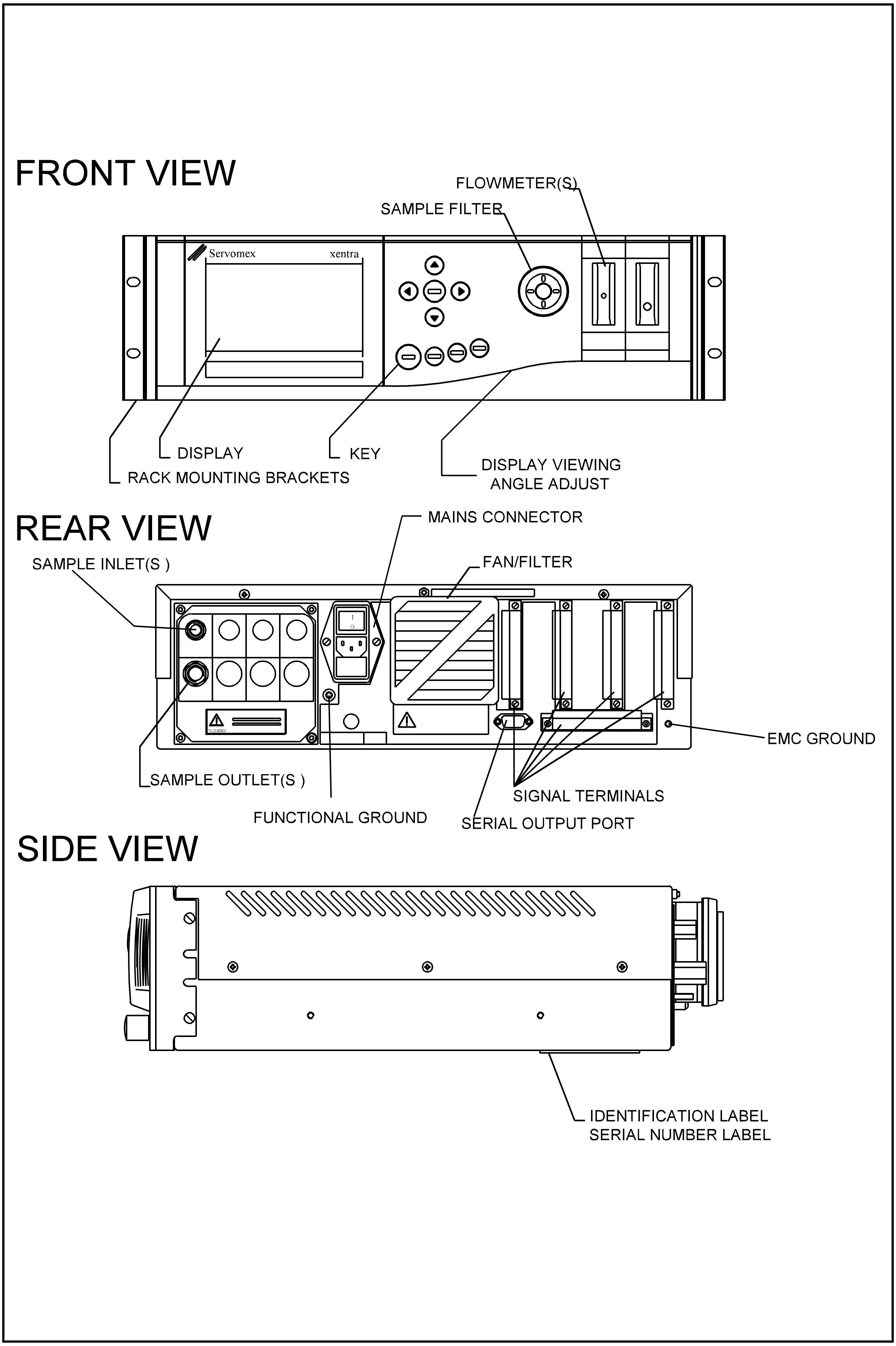

Figure 1.1 Key features of the Xentra

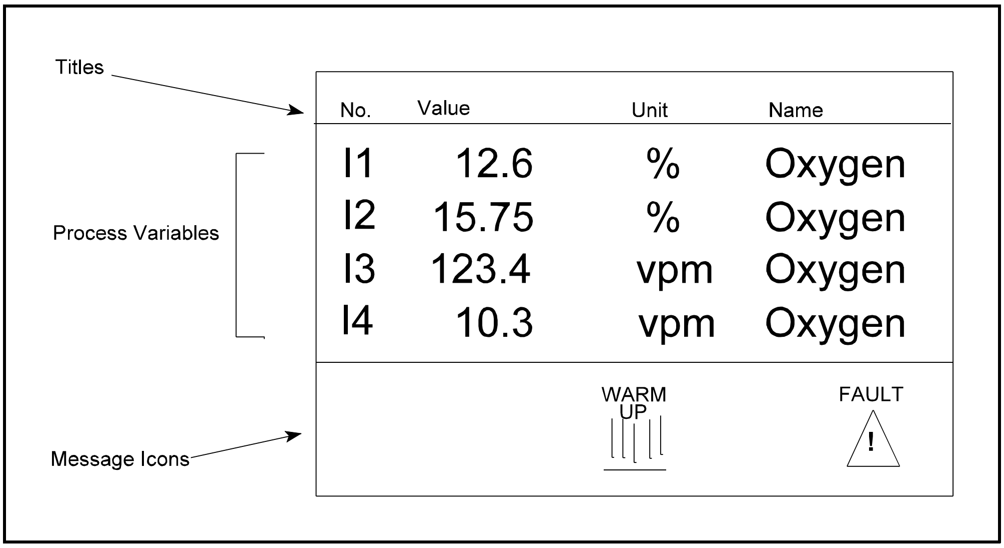

Figure 1.2 Xentra measurement display

Each measured value on the display is known as a process variable and consists of four fields as shown in figure 1.3.

No.	A module location field (2 characters).
Value	A measurement value field (6 characters).
Unit	An engineering units field (3 characters).
Component	A user defined message (UDM) field (6 characters).

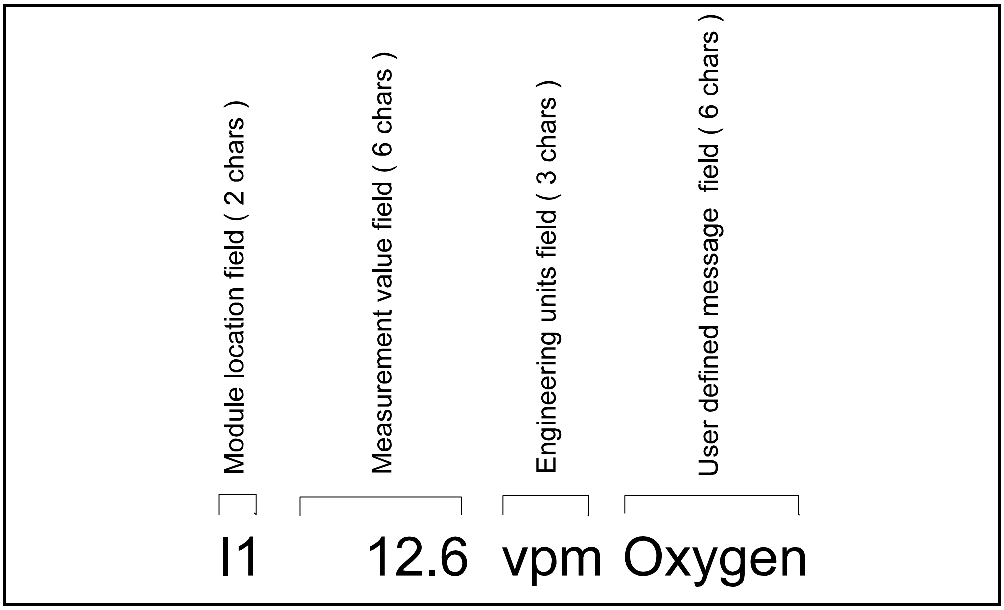

Figure 1.3 Xentra process variable format

The module location field defines which transducer the process variable represents. The letter 'I' indicates an internal gas sensor module, the letter 'E' indicates an external gas transducer (user supplied). The letter is followed by

a number defining the gas sensor module site number.

The measurement field is a 6 character number representing the concentration measured.

The engineering units field is a user defined 3 character message identifying the units of measurement. The engineering units field is a message only. Changing the engineering units message has no effect on the displayed value.

The user defined message (UDM) field is a 6 character field to represent the process variable name or tag number.

The Xentra display may be returned to measurement display at any time by pressing the 'MEASURE' key (see figure 1.4). If no user key presses are input then the Xentra returns to the measurement display after a one minute time out. This time-out is extended to 20 minutes during the calibration options.

When first powered up, the display will show a sequence of power up messages before returning to the measurement display. If the user does not wish to see the power up messages then these can be disabled by pressing the measure key during the 'SYSTEM OK' message. The warming-up icon (see figure 1.5) will also be displayed until all gas sensor modules are at their respective operating temperatures. This may take up to 3 minutes for zirconia gas sensor modules and 6 hours for paramagnetic gas sensor modules. The reading of any zirconia gas sensor module may be replaced by a row of stars ('******') during the warming-up period.

Icons located at the bottom of the measurement display indicate the status of the instrument (see figure 1.5). These icons show that the instrument is warming up or being calibrated via the internal autocalibration facility. Icons also indicate the presence of alarms or faults. If the fault or alarm icons appear on the measurement display the exact nature of the fault or alarm may be determined via the user interface, (see 1.8 'Displaying alarms present' and 1.9 'Displaying faults present').

1.4.2 The Xentra keypad

User input to the Xentra instrument is via the Xentra keypad. A view of the keypad is given in figure 1.4.

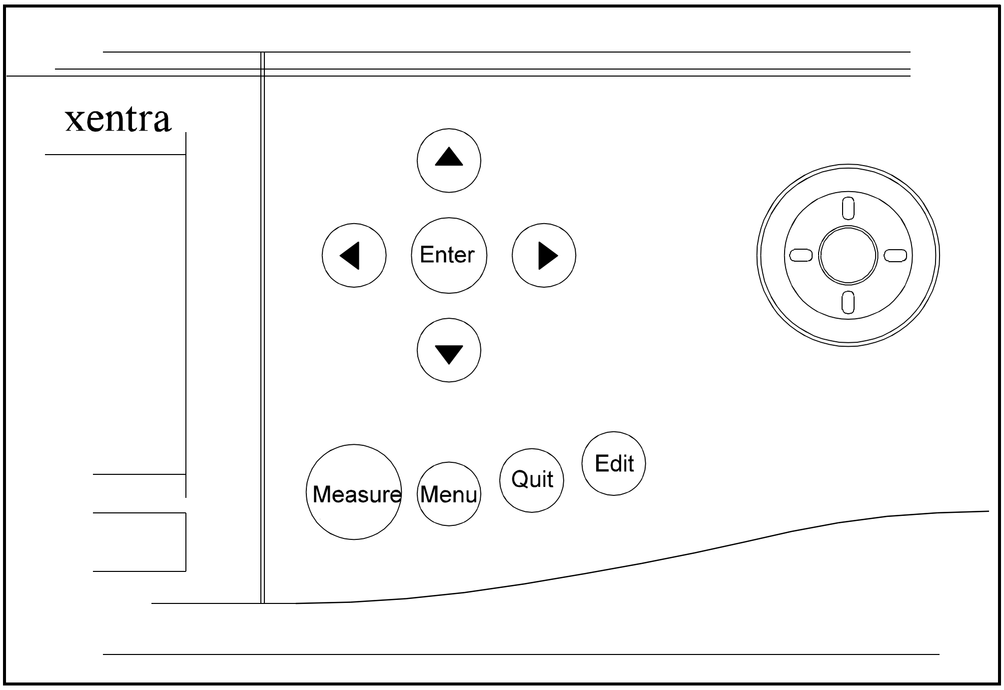

Figure 1.4 The Xentra keypad

The functions of the keys on the Xentra keypad are as follows.

Measure key

Pressing the 'MEASURE' key at any time returns the instrument to the default measurement display (see section 1.4.1).

Menu key

Pressing the 'MENU' key activates the Xentra top level menu.

Quit key

Pressing the 'QUIT' key aborts the current activity and returns the user interface to the menu level at which the activity was selected. Pressing the 'QUIT' key while in the top level menu has no effect.

Edit key

Pressing the 'EDIT' key and entering the appropriate password will give immediate access to the edit functions provided to modify the text on the measurement display. This includes the names of measured variables, the measurement units, the displayed precision and the filtering applied.

> ?= < keys

Within menu displays the user highlights the desired option using the arrow keys(> ? = <) and then presses the 'ENTER' key.

When entering numeric information or text, the left and right arrow keys (= <) are used to move between characters or digits and the up and down arrow keys (> ?) are used to change each character or digit. Reverse video is used to indicate the active WORD, character or digit position.

Enter key

The user presses the 'ENTER' key to indicate that the indicated menu selection is to be actioned or to indicate completion of text or numerical input. If, when inputting text or numerical data, the key press is ignored then this is because the data entered is invalid; otherwise the data will be saved.

1.4.3 The Xentra screen icons

The space at the bottom of the measurement display is reserved for status icons. The screen icons that may be displayed are shown in figure 1.5.

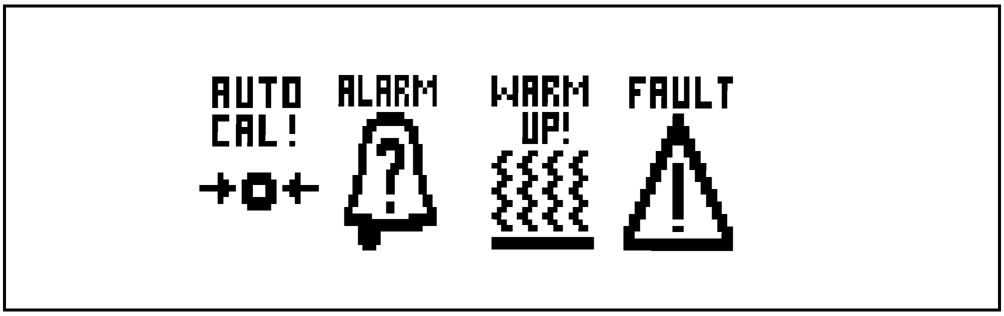

Figure 1.5 Xentra status Icons

The function of these icons is as follows:-

Autocal icon

This icon is displayed when an instrument auto calibration is in progress.

Alarm icon

This icon is displayed if any of the user defined alarm levels are triggered. If this icon is displayed then the nature of the alarm may be found from the user interface (see section 1.8 'Displaying alarms present').

Warm Up icon

This icon is displayed if any of the transducers fitted inside of the Xentra are operating at a temperature less than their normal operating temperature band. This is normally displayed when the instrument is turned on. If any of the transducers fails to achieve its normal temperature operating conditions within a specified time then the warm up icon will be turned off and a fault icon raised.

Fault icon

This icon is displayed if a fault condition is identified within the analyser. The cause of the fault may be identified from the user interface (see section 1.9 'Displaying faults present').

1.4.4 The Xentra menu display

To initiate any user interface menu operation the 'MENU' key should be pressed. The Xentra will then present the top level menu, which in turn leads on to other menus. A tree showing the menu structure in its entirety is given in figure 1.6.

At each menu the user highlights the desired option using the arrow keys (> ? = <) and then presses the 'ENTER' key. Reverse video is used to highlight the selected menu option. Pressing the 'MEASURE' key at any time returns to the measurement display.

The 'EDIT' key is used as a short cut key. Pressing the 'EDIT' key will give more direct access to the edit functions provided to modify the text on the measurement display. This includes the names of measured variables and the measurement units.

During any user interface operation, the fundamental measurements are still being made by the Xentra and all relevant outputs, alarms and diagnostics remain active. The time and date are retained for at least two days while the analyser is switched off, the configuration and all calibrations are retained indefinitely.

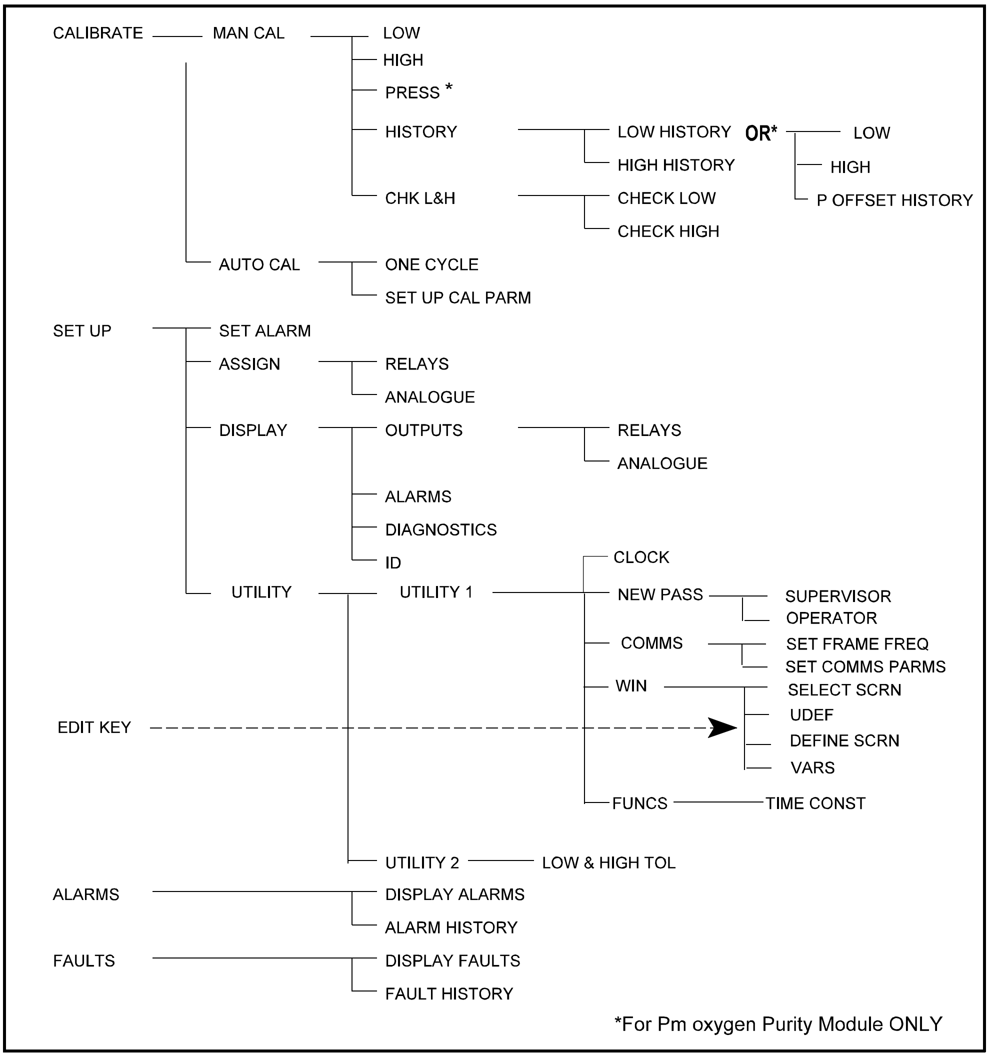

Figure 1.6 User interface menu map

1.4.5 Numeric data input

When numeric data input is required then a field of individual digits will be offered to the user. Each of these digits is edited independently using the arrow keys (> ?= <). For numeric information each digit position may be changed to :-

i) Any number in the range 0 to 9
ii) A decimal point
iii) A minus sign

The minus sign may only be positioned in the first character.

The position of the decimal point may be changed from that offered as a default. Any digit position except the right most digit may be used for the decimal point.
The following are examples of valid numeric data entries:-

-.2033
-0100

The following is an example of an invalid data entry:-

-9999. (Last character should not be decimal point)

If an invalid data entry is made at a point in the user interface then the input will be ignored and the display return to the start of the data entry screen that precipitated the invalid entry. No warning message will be generated.

NOTE
If the Measure, Menu or Quit keys are used to terminate a data entry (rather than the Enter key) then the data entered is lost.

1.4.6 Password protection

Some user interface operations require the use of a password. There are two passwords, a supervisor password which gives access to SETUP and CALIBRATION and an operator password which gives access to CALIBRATION only. Both of the passwords are factory set to 4000, these may be changed if required.

1.5 Transducer site numbering system

The Xentra chassis may accommodate a number of internal transducers which are assigned site locations represented as I1, I2, I3 and I4 on the display.
Up to four transducers may be connected on separate gas streams so that two or more transducers of the same type may be present. The site location code provides a means of distinguishing these transducers.

1.6 Output numbering system

The outputs from the Xentra have a two digit identification number of the following format : Card number **.** Output

e.g. the outputs fitted as standard in card position 1 are :

1**.**1 Analogue output
1**.**2 Analogue output
1**.**3 Relay (Contacts normally open)
1**.**4 Relay (Contacts normally open)
1**.**5 Relay (Contacts normally open)

These identification numbers appear on the rear label to identify the terminals where each output appears and on the display when the outputs are being configured.

1.7 Transducer full scale deflection

The transducer full scale deflection (FSD) is the maximum concentration level that may be measured and displayed with the precision and accuracy specified for that transducer. This may also be termed the measurement range for the transducer. Concentration levels that exceed 120% of the FSD are considered as over range and are indicated by the word ‘OVER’ on the analyser display, which “flashes”, alternating with the actual measured value of the gas concentration.

There are three set up parameters on the Xentra instrument that are expressed in terms of the FSD.

- Calibration tolerances for the transducers.
- Alarm hysteresis.
- The upper limit of the analogue output.

The maximum FSD values for the different transducer types that may be fitted inside the Xentra 4100 chassis are shown in table 1.1.

Table 1.1 Transducer maximum FSD values

Transducer	FSD
Pm 1156 O_2 Control	100 % O_2
4100995 O_2 Purity	100 % O_2
Zirc 704 O_2 Trace	210000 vpm O_2 (21%)
Zirc 703 O_2 Trace	210000 vpm O_2 (21%)
Gfx 1210 CO_2 Trace	100 vpm CO_2
Gfx 1210 CO Trace	500 vpm CO
Gfx 1210 N_2O Trace	500 vpm N_2O
Gfx 1210 CH_4 Trace	500 vpm CH_4

1.8 Displaying alarms present

If the measurement display shows the 'ALARM' icon the number and nature of the alarms present may be determined using the procedure described in Table 1.2.

Table 1.2 Displaying alarms present	
L MENU to obtain top level menu	
CALIBRATE/SETUP ALARMS/FAULTS	**L** ? ENTER
DISPLAY ALARMS ALARM HISTORY	**L** ENTER
I2 Oxygen AL1 99.98 % HIGH 8	The first alarm is displayed, if further alarms are present an arrow will be shown, **L** > or ? to access information on further alarms. When alarms have been viewed **L** MEASURE to return to measurement display.

1.9 Displaying faults present

If the measurement display shows the 'FAULT' icon the number and nature of the faults present may be determined using the procedure described in Table 1.3.

Table 1.3 Displaying faults present	
L MENU to obtain top level menu	
CALIBRATE/SETUP ALARMS/FAULTS	**L** ? < ENTER
DISPLAY FAULTS FAULT HISTORY	**L** ENTER
I1 CELL TEMP LOW 8	The first fault is displayed, if further faults are present an arrow will be shown, **L** > or ? to access information on further faults. When faults have been viewed **L** MEASURE to return to measurement display.

1.10 Displaying alarm history

An entry is made in the alarm history buffer each time an alarm appears or is cleared. The alarm history buffer contains the most recent 40 events. Note that if hysteresis has been specified when configuring an alarm, then the alarm will not clear until the concentration has reached the alarm level plus the hysteresis. Table 1.4 describes the procedure for displaying the alarm history.

Table 1.4 Displaying alarm history	
L MENU to obtain top level menu	
CALIBRATE/SETUP ALARMS/FAULTS	L ? ENTER
DISPLAY ALARMS ALARM HISTORY	L ? ENTER
I2 Oxygen AL2 ON 12:13:20 12/06 8	L > or ? to view further entries L MEASURE to return to measurement display

1.11 Displaying fault history

An entry is made in the fault history buffer each time a fault appears or is cleared. The fault history file contains the most recent 40 occasions where a fault appeared or was cleared. Table 1.5 describes the procedure for displaying the fault history.

Table 1.5 Displaying fault history	
L MENU to obtain top level menu	
CALIBRATE/SETUP ALARMS/FAULTS	L ? < ENTER
DISPLAY FAULTS FAULT HISTORY	L ? ENTER
I1 CELL T LOW ON 12:13:20 12/06 8	L > or ? to view further entries L MEASURE to return to measurement display

1.12 Displaying calibration history

An entry is made in the calibration history buffer each time a calibration or calibration check is performed. The calibration history file contains the most recent 40 occasions when a calibration or check was performed. The following data is recorded for each occasion

The information is displayed in the following format :-

[gas sensor module site number] [measurement name] [type of calibration] [difference] [time and date]

e.g. The display for a manual low calibration of the Oxygen sensor in site 3 with a correction of !0.213 at 14:54 on 24th July would be:

I3 Oxygen CML !0.213
14:54:20 24/07

Calibration types:	C or V	**C**alibration or calibration check (**V**alidate).
	M or A	**M**anual or **A**uto.
	L or H	**L**ow or **H**igh.
	MPO	**M**easure **P**ressure transducer **O**ffset *
	SPO	**S**pecify **P**ressure transducer **O**ffset *

Difference: Difference between measured and actual concentration, (current measured value **-** target value of calibration sample, i.e. a positive number indicates a positive drift).

* Applicable to paramagnetic gas sensors only.

Table 1.6 contains the an example procedure for displaying the calibration history.

NOTE

The history may include reference to other gas sensor modules. Some of these may be of the same type.

Table 1.6 Displaying paramagnetic purity gas sensor calibration history	
L MENU to obtain top level menu	
CALIBRATE/SETUP ALARMS/FAULTS	L ENTER
MANUAL CAL AUTO CAL	L ENTER. Note that "AUTO CAL" will only appear when the analyser is configured with the autocalibration option.
ENTER PASSWORD 0000	To change the value of a digit L > or ? To change to another digit L = or < When the value shown is correct L ENTER
CALIBRATE I2 Oxygen % 8	To select desired gas sensor module L > or ? then L ENTER, if only one module is fitted this section will be omitted.
LOW CAL/HIGH CAL HISTORY/CHK L&H	L ? ENTER
LOW HISTORY HIGH HISTORY	L ENTER to view Low cal history L ? ENTER to view High cal history
I2 OxygenCML0.213 01:15:20 28/118	L > or ? to view further entries L MEASURE to return to measurement display

1.13 Displaying diagnostics information

The signals from gas sensors may be displayed. These may be useful in diagnosing any problems which may arise. The procedure for displaying diagnostics information is described in Table 1.7.

Table 1.7 Displaying diagnostic information

L MENU to obtain top level menu	
CALIBRATE/SETUP ALARMS/FAULTS	L < ENTER
SET ALARM/ASSIGN DISPLAY/UTILITY	L ? ENTER
OUTPUTS/ALARMS DIAGNOSTICS/ID	L ? ENTER
I2 CELL EMF 0.234 Volts 8	L > to view further diagnostics information
I2 CELL TEMP 35.5 °C 8	L > to view further diagnostics information
I1 CO2 DIF SIG 0.003 Volts 8	L > to view further diagnostics information
I1 CO2 GAS SIG 0.900 Volts 8	L > or ? to view further diagnostics information L MEASURE to return to measurement display

SECTION 2: INTRODUCTION

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2 PRODUCT OVERVIEW

2.1 Mechanical Overview

2.1.1 General

Refer to figure 6.1

The Xentra consists of a sheet metal chassis [4] and cover [3] fixed with either 9 (Xentra 4102) or 11 (Xentra 4104) screws [2]. The chassis contains the gas sensor modules, associated electronics and sample system. On the front of the chassis is a plastic moulded fascia [5] which is used to mount the display and keypad. Mounted on the front of the chassis but projecting through the fascia are a sample filter and two Flowmeter which are optional. The fascia is fixed to the chassis using 8 screws (Figure 6.2[13]).

2.1.2 Optional Flowmeter(s)

Refer to figure 6.2

The Flowmeter consists of a flow tube [9,10] supported between end-blocks [7,8,38,39]. The end-block spigots accommodate 'o' rings [11,12] which seal to the flow tubes. Each flowmeter has a moulded plastic cover [4,5] which provides access to the flow tube [9,10] for cleaning. When the Flowmeters are not fitted the cover is replaced by a blank. The cover or blank is fixed by a screw [3] accessible from inside the chassis [42].

2.1.3 Optional Sample Filter - Internal

(See 2.1.16 for external sample filter)

Refer to figure 6.2

The sample filter housing [26] has a clear polycarbonate cover [32] which may be unscrewed with the aid of the spanner provided with the Xentra to gain access to the filter element [33]. The filter cover [32] is sealed to the filter housing using an 'o' ring [34]. When the sample filter is not fitted a blank is fitted to the fascia [29]

2.1.4 Keypad

Refer to figure 6.2

The keypad consists of a PCB [21] and a silicone rubber overlay [22]. The rubber overlay has nine keys moulded into it, each has a rubber contact pill which makes contact with the PCB when the key is pressed. The fascia has

five locating pegs [28] which are used to locate the rubber overlay and keypad PCB. The keypad is then fixed to the fascia using four screws [20] with the rubber overlay sandwiched between. One of the keypad PCB fixing screws has a spacer [27] which prevents the screw breaking through the front of the fascia.

The invertor [41] which provides a high voltage for the cold cathode fluorescent lamp is mounted on the keypad PCB. The potentiometer for adjustment of the display viewing angle is mounted on the keypad PCB [21].

2.1.5 Fascia EMC components

Refer to figure 6.2

The display window [43] is fixed into the fascia independently of the display. The inner surface of the window is metallised, this metallisation is connected to a conductive coating on the inner surface of the fascia by copper tape with conductive adhesive [30]. A web wall on the inner surface of the fascia which goes around the display and keypad carries an EMC gasket [31], this is used to connect to the front of the chassis thus providing a complete conductive envelope around the keypad and display.

2.1.6 Display

Refer to figure 6.2

The display is fixed to the fascia by four screws [23], it has no user serviceable parts.

2.1.7 Card frame

Refer to figure 6.9

The card frame, mounted at the rear of the chassis, consists of a front card-frame [10] and a rear card-frame [7]. Both card-frames have snap-in plastic card guides [11]. The front card frame fixes to two studs in the base of the chassis. The rear card-frame is suspended from the top rear of the chassis using two screws [3] which fix into threaded inserts in the chassis. The Motherboard [9] is suspended between the two card-frames. The Motherboard has threaded inserts which are used to fix it to the card-frames using four screws [5]. Three fixings are provided at the rear of the Motherboard and one at the front. The front of the Motherboard protrudes through the front card-frame to give support in the region of the connector

Between one and four Terminal boards [6] may be fitted. These plug into the Motherboard, but the connector which is presented to the customer at the

rear of the chassis is sandwiched between the rear of the chassis and the rear card-frame. Thus the Terminal boards form an integral part of the card-frame. The following boards plug into the Motherboard and are supported by card-guides:

Refer to figure 6.4

Power supply [19]
Microprocessor [6]
Sensor interface [2]
Three option boards [3,4,5]
Multiplexer board [1]

The Power supply has a metal case and is given additional support by a screw (Figure 6.4 [18]) which fixes it to the card frame. All boards which plug into the Motherboard have handles to aid extraction except the Microprocessor board and power supply.

2.1.8 Power connector

Refer to figure 6.4

The power connector [9], provides mains voltage selection, fusing and a power switch. It is fixed to the rear of the chassis by two screws [8] which have corresponding threaded inserts in the rear of the chassis. An earth lead soldered onto the IEC power connector is connected to the earth stud [22] on the inside rear of the chassis. This earth lead is kept as short as possible for EMC. The IEC power connector is connected to the Motherboard via a four leads in an overall sleeve. A four way connector [11] is used to make connections to the Motherboard. Four individual insulated slide connectors are used to connect to the IEC power connector.

2.1.9 Transformer

Refer to figure 6.4

The transformer [17] is fixed to the chassis from the underside using two screws with washers [15,16]. These fix into threaded bushes potted into the centre of the toroidal transformer. A rubber mat [23] is fitted to the underside of the transformer.

2.1.10 External fan

Refer to figure 6.6

The external fan [1] is fitted to the rear of the chassis along with a finger guard [3] and a fan mounting plate [2] using four screws [7] which fix into threaded inserts in the chassis. The four screws pass through spacers [8]. The fan mounting plate spreads the force of the fixing screws on the fan and helps prevent the fan filter element [4] , fan filter gauze [5] and fan filter cover [6] from being dislodged. These components would otherwise protrude as they are slightly larger than the fan itself. The fan is connected to the Motherboard [9]. The direction of flow is marked on the fan, this is directed into the chassis.

2.1.11 Optional Internal Fan

Refer to figure 6.7

The internal fan [2] is used where the gas sensor modules have a high power dissipation. It is connected to the Motherboard [7] using connector [6]. The internal fan is fixed to the front card-frame [8] using four screws with nuts and washers [4,3,5]. A fan mounting plate [1] is used to space the fan of off the front card-frame so that the fan rotor does not touch the card frame.

2.1.12 Sample System Options

The 4100 is offered with a choice of two sampling systems, flow driven and pressure driven. These sampling systems are transducer module dependent and a multi measurement analyser could contain a mixture of both. The specific analyser configuration can be accessed via the user interface, where the feature and options for the build are stored. For a full list of the features and options refer to the 4100 Gas Purity Analyser Technical Data Sheet, available from your local Servomex Company, agent, or representative.

Flow Driven Option

Refer to Figure 2.1

The flow driven option is supplied for applications where the sample flow is to be controlled by the customer, prior to entry into the analyser. Minimum and maximum flows are transducer module dependent. For more detail on transducer module specific flowrates please refer to the QuickStart manual.

Pressure Driven Option

Refer to Figure 2.2

The pressure driven option has been specifically designed to maintain optimum sample flowrate for an inlet pressure of 5psig +/- 3psig (35kPag +/- 21kPag). The sample system operates by restricting the sample flow and redirecting excess sample down a bypass route to the outlet. The system will accommodate minor changes in inlet pressure but a stable inlet pressure is recommended.

2.1.13 Gas sensor modules

Zirconia example shown in Figure 6.10.

The gas sensor modules mount to the base of the chassis using studs fixed into the chassis base [16]. The studs are fitted with nuts with integral locking washers. The gas sensor modules are provided with slots so that the nuts do not need to be removed from the mounting studs. Once the nuts are loosened the gas sensor module may slide sideways then upwards for removal.

2.1.14 Maintenance of EMC performance

Refer to figure 6.3

To ensure that EMC performance is maintained all cover screws should be refitted and tightened. The conductive gaskets[1] along the front edge of the chassis [6] and those on the fascia should also be fitted and replaced where necessary.

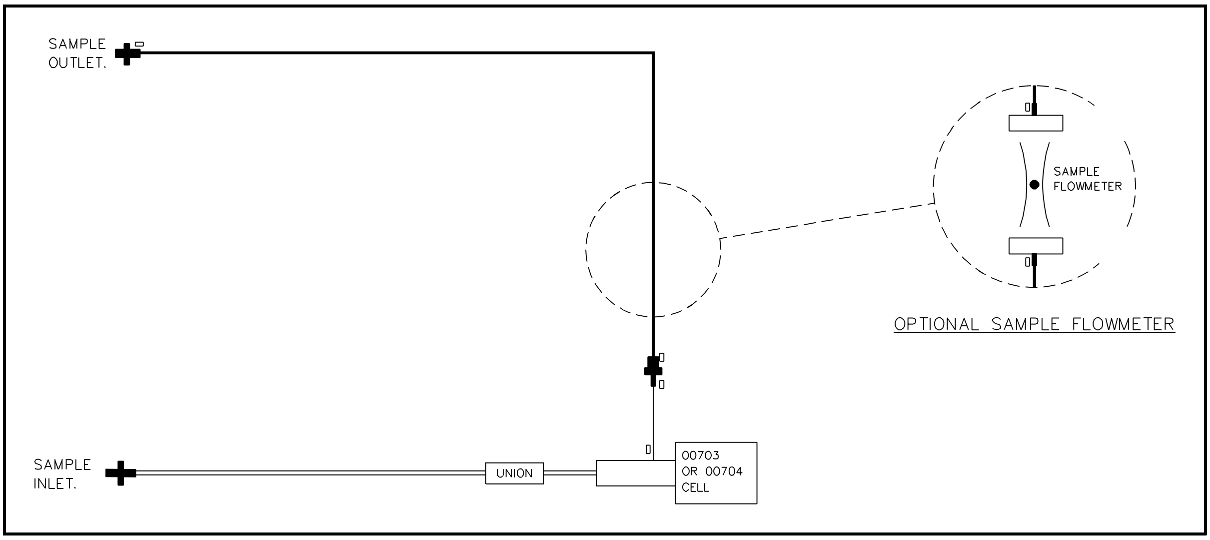

Figure 2.1 Typical schematic for flow driven Zr oxygen Trace sample system.

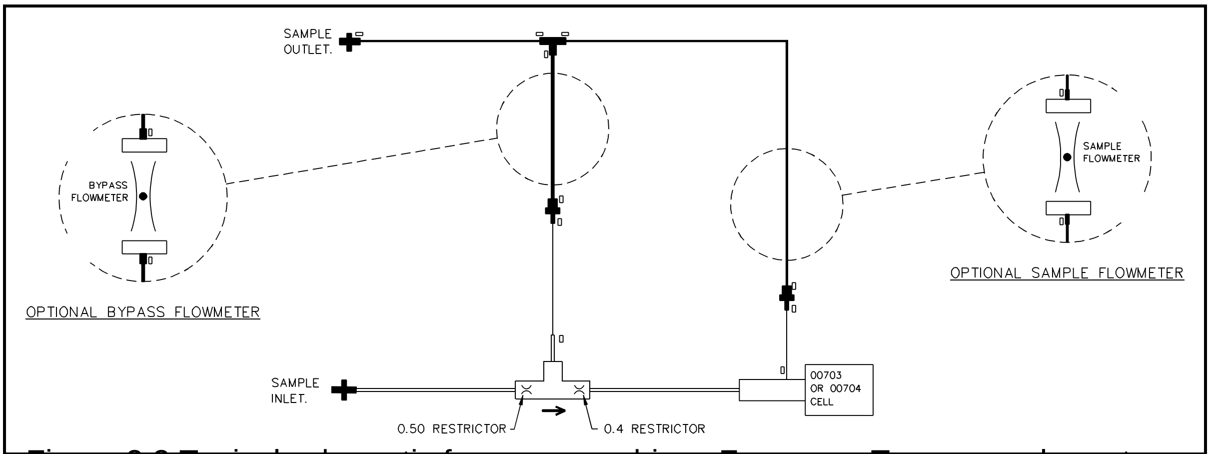

Figure 2.2 Typical schematic for pressure driven Zr oxygen Trace sample system.

2.1.15 Sample connections

WARNING

The sample and calibration gases supplied to the instrument may be toxic or asphyxiant. Verify that connections are leak free at full operating pressure before proceeding with admitting toxic samples.

Instrument vent gases may also be toxic or asphyxiant and should be treated accordingly. They should not be vented into an enclosed area.

The instrument is not suitable for operation with flammable or corrosive gas samples.

Before performing any service operation ensure that the instrument sample system has been flushed with inert gas before opening sample connections. This is to prevent accidental exposure to toxic or asphyxiant gases.

Sample and calibration gases pass into and out of the chassis via a gland plate mounted on the rear of the chassis. The versionof the gland plate will depend on which auto calibration option has been supplied.

Pressure or flow driven non autocalibration units

The sample gland plate without autocalibration is shown in figure 2.3. This provides up to four sample inlets and a corresponding outlet for each inlet. A single sample inlet is provided for each gas stream.

Pressure or flow driven internal autocalibration units

When the *internal* autocalibration feature (paramagnetic only) is supplied a valve manifold is mounted in the sample gland plate (see figure 2.4). This provides ports for sample inlet and outlet plus additional inlets for two calibration gases. The autocalibration manifold is installed on gas stream 1. Again a single sample inlet is provided on each gas stream. This option is not suitable for use with toxic samples.

Pressure or flow driven external autocalibration units

The gland plate supplied for the *external* autocalibration option (see figure 2.5). There are no inlets for calibration gas. Instead an electrical connector carries drive signals which may be used to control solenoid valves mounted outside the instrument case.

Sample port sizes and thread types are given in table 2.1.

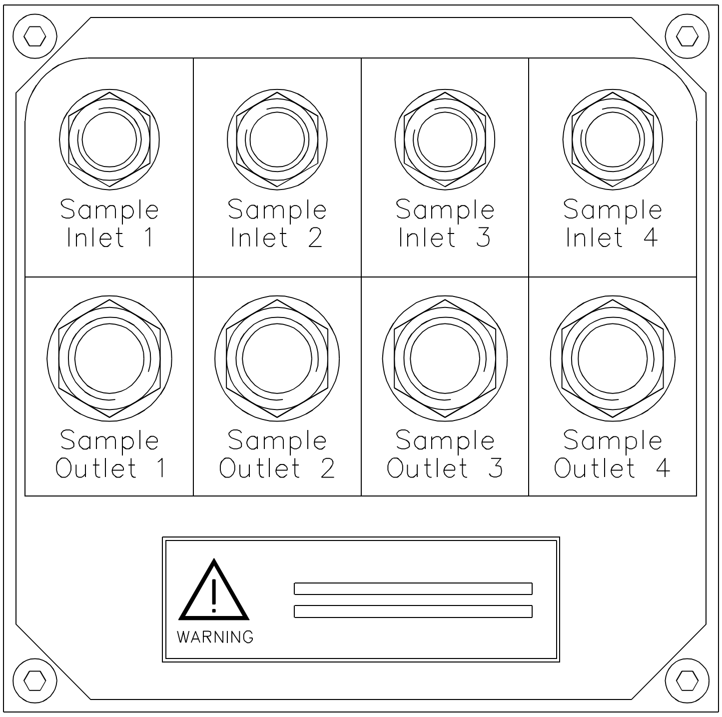

Figure 2.3 Sample gland plate without auto calibration

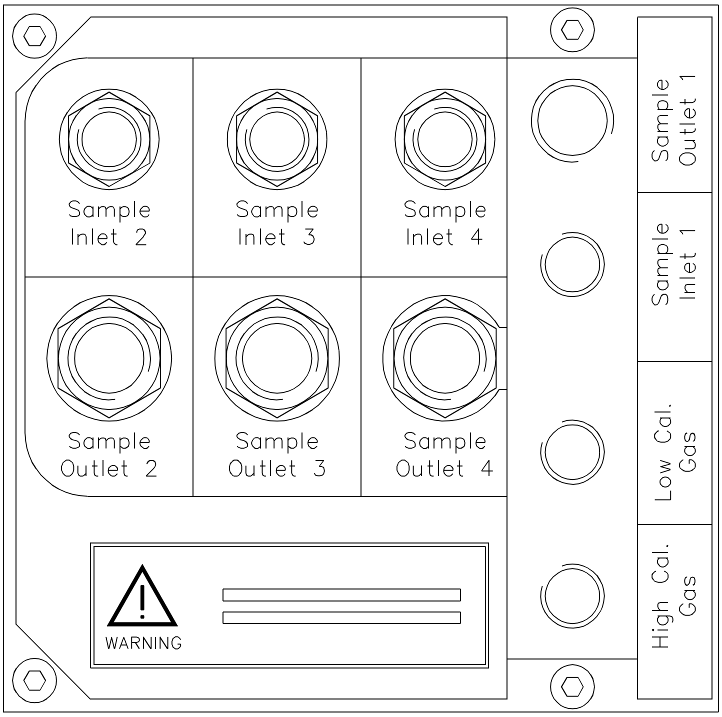

Figure 2.4 Sample gland plate with internal auto calibration

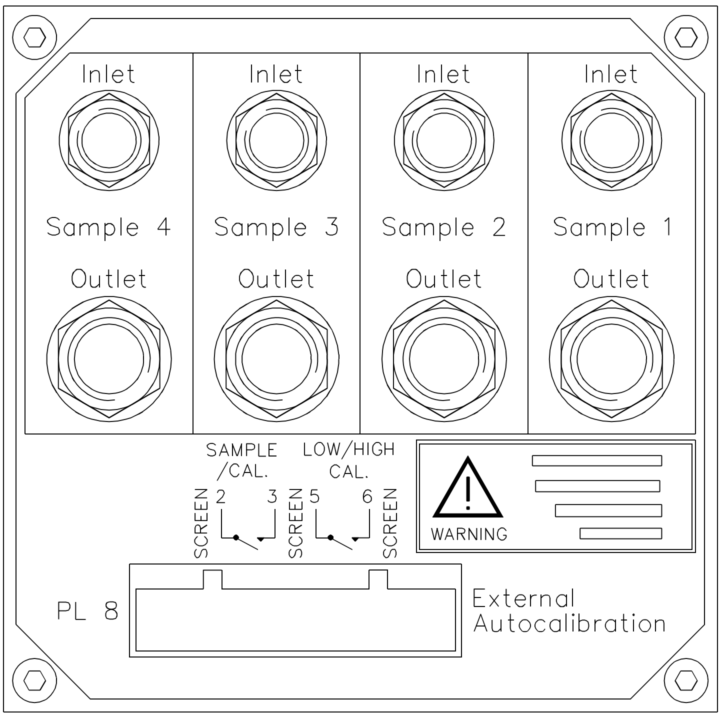

Figure 2.5 Sample gland plate with external auto calibration

Table 2.1 Sample ports					
	Transducer	Sample Inlet	Sample Outlet	Low cal gas	High cal gas
Internal autocal	Paramagnetic only	**c** ” NPT female	¼” NPT female	**c** ” NPT female	**c** ” NPT female
Standard or external autocal	Paramagnetic	**c** ” NPT female	¼” NPT female	N/A	N/A
	Zirconia	**c** ” OD male*	¼” NPT female	N/A	N/A
	Gfx	**c** ” OD male*	¼” NPT female	N/A	N/A

*

2.1.16 External filter

An external filter (stainless steel) may be fitted to the inlet of either Zirconia sensors or Infrared benches. In which case the inlet connection will be 1/8" swagelok compression.

2.2 Electrical Overview

2.2.1 Power distribution

Mains power

Refer to figure 6.4

Electrical power enters the analyser via an IEC CE22 connector [9]. This connector provides an ON/OFF switch, filtering and mains voltage selection as well as fusing. Power is taken on to the Motherboard [20] via a 4 way connector [11]. Mains power is distributed on the Motherboard to the transformer [17] via a 4 way connector [12] and to the switched mode power supply [19] which plugs directly into the Motherboard.

Transformer

The transformer has split primary windings allowing voltage selection between 85 to 132V ac or 170 to 264V ac. The transformer provides power for the gas sensor modules and an auto transformed tapping for auxiliary power, this tapping is not used on the Xentra 4100. The auxiliary power tapping is fused via F2 which is mounted on the Motherboard but accessed from the rear of the chassis. Each primary winding has an self-resetting over-temperature cutout, which operates at 110°C. .

There are two versions of the transformer, one provides power for two gas sensor modules and the other provides power for four gas sensor modules. The transformers have one secondary winding per gas sensor module, nominally 18-0-18 V ac.

Gas sensor module power

Refer to figure 6.4

The transformer secondary windings are connected to the Motherboard via a connector [13]. The secondary windings are then routed on to the Multiplexer board [1] via connector [22]. Each secondary winding has two soldered-in fuses on the Multiplexer board. The secondary windings are then routed to the gas sensor modules via four connectors on the Multiplexer board.

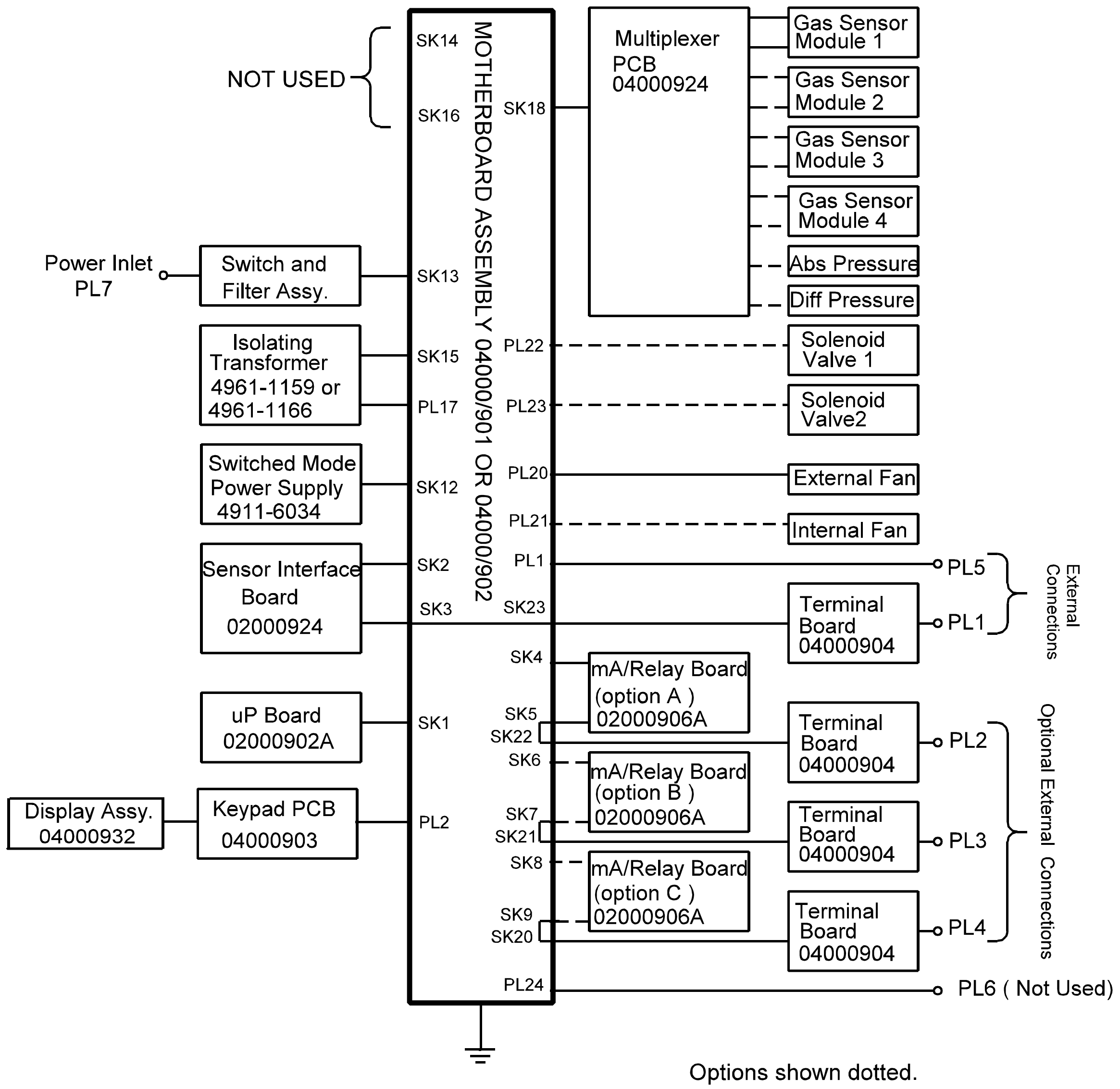

Figure 2.6 Electronic system block diagram

Switched mode power supply

Refer to figure 6.4

The switched mode power supply [19] operates between 85 to 264V and is not affected by mains voltage selection. It provides +15V, -15V, +5V and 24V isolated supplies. The isolated 24V positive supply is grounded on the Motherboard to generate -24V for the display viewing angle adjustment.

A short circuit or overload on the 24V rail will shut down all of the outputs. These will run at approximately 0.5V as the power supply tries to restart. A short circuit or overload on the +5V, +15V or -15V rails will not affect the other rails.

Display lamp drive

The display lamp runs at approximately 300V ac 4 KHz, the voltage required to strike the lamp initially is 1.5KV. The lamp is driven from an invertor mounted on the keypad PCB which uses the 24V supply.

2.2.2 Signal processing

Standard gas sensor module connector

The Gas sensor modules and Multiplexer board are connected via a 20 way ribbon cable. All Gas sensor modules have a common pin-out. This means that Gas sensor modules may be plugged into any of four positions on the Multiplexer board.

Signal multiplexing

Refer to figure 6.4

The Sensor interface board [2] has one digital input and one analogue input for interfacing with transducers. Analogue and digital signals are multiplexed into these inputs using three 'probe select' (or transducer select) lines to select which transducer is accessed and four 'control lines' to select which signal within the transducer is to be accessed. The multiplexers are on the Multiplexer board, the 'probe select' and 'control' lines are generated from the Sensor interface board.

Signal scaling

The gas sensor modules used in the Xentra output 0 to 1 V signals, the Multiplexer board re-scales the signals. The signals are multiplied by 2 and a 0.5 V offset added, finally the signals are potted down to 80%. The A to D has a full scale of 2.5V. The 0.5V offset provides under range and the 80% pot down provides over range.

Removal of offset variation

The 0.5V offset may vary. In order to null out this variation the software accesses a 0V input signal and measures the actual 0.5V level. This offset null occurs once per minute.

Span voltage reference

To reduce the span temperature coefficient of the electronics a span reference voltage is provided which is read once every ten seconds. If the resultant reading is outside of acceptable limits the A-D convertor is re-calibrated. If the reading is still outside of acceptable limits after three calibration attempts, a fault is indicated. The A-D has digital registers and may occasionally be corrupted by electrical interference. However this should be self correcting unless the interference is persistent.

2.2.3 Solenoid valve drives

The four control lines are latched into a 'D' type latch on the Multiplexer board, two of these latched lines are used to drive the solenoid valves via transistors.

2.2.4 Microprocessor board

Refer to figure 7.1

The Microprocessor PCB [1] (also, figure 6.4 [6]) runs software specific to the gas sensor module population and interfaces to the following via the microprocessor bus: Display, Keypad, Sensor interface board and option boards. The software is contained in two EPROMS [4,5] which are known as 'Firmware' once programmed. The microprocessor board also contains RAM [6,7] for temporary data storage, EEPROM [8] for indefinite storage of calibration and set-up information such as analogue output ranging and a real time calendar/clock which continues to keep time during power down by drawing power from a super-capacitor. The super capacitor will power the calendar/clock for between 2 days and 2 weeks.

Note: If the analyser is powered up with either its sensor interface board or any option boards removed any set-up information for those boards will be lost.

The green LED at the top of the microprocessor board indicates that the microprocessor is not being reset when illuminated continuously. The microprocessor board contains a watchdog timer which must be re-initialised by the software every half second. If the software fails to re-initialise the watchdog the microprocessor will be reset thus extinguishing the green LED momentarily. If the software can not run eg because the RAM has failed the microprocessor will be continually reset, under these circumstances the green

LED appears to flash.

The two red LED's at the top of the microprocessor board are extinguished by the software when memory checks have been completed following a reset. Following successful memory checks the message 'SYSTEM OK' will appear on the display. Table 2.2 shows the sequence of LED states.

TABLE 2.2 MICROPROCESSOR LED STATES

State	D3 RED	D2 RED	D1 GREEN
Initial state, microprocessor is reset	ON	ON	OFF
Reset line released	ON	ON	ON
RAM test OK	ON	OFF	ON
EPROM test OK	OFF	OFF	ON

2.2.5 Sensor interface board

The sensor interface board consists of the following: digital outputs for multiplexing of signals, an A to D convertor to receive multiplexed analogue signals , a digital input for multiplexed digital signals, two isolated analogue outputs and three volt free relay contacts. The board provides an identification code which the microprocessor can read to identify that the board is fitted is of the correct type.

2.2.6 Option boards

Option boards are depopulated versions of the Sensor interface board. Which have dual relays plus dual isolated current outputs.

2.2.7 Multiplexer board

The multiplexer board buffers signal from the gas sensor modules, provides offset and scaling and routes them to the Sensor interface board via the Motherboard. Routing of the signals is performed using multiplexers under control of the microprocessor. Electrical power is provided to the gas sensor modules from the Multiplexer board.

The multiplexer board also provides signal routing and multiplexing for the two external analogue inputs.

The pressure transducer sites (SK1 & SK2) on the multiplexer board are not used on the 4100.

A 2.5V voltage reference is provided for span compensation of the electronics, this signal is read via the A-D convertor and the compensation performed by software.

The control lines from the Sensor interface board are fed into a 'D' type latch and latched in under control of the microprocessor to drive the solenoid valves via a drive transistor.

2.2.8 Mother board

The Mother board has no active components. It is used to connect the following items: Switched mode power supply, microprocessor board, Sensor interface board, option boards, Terminal boards, Multiplexer board, transformer, fans and solenoid valves. Two versions of the Mother board are available, one provides for one option card and one provides for three option cards.

The Mother board carries a fuse for the transformer auxiliary winding which is accessible from the rear of the chassis. A terminal block which is accessible from the rear of the chassis is provided for connection of: external current inputs with validation signals, range change input, autocal initiate input.

2.2.9 Terminal board

Between one and four Terminal boards may be fitted. The isolated current outputs and relays from the Sensor interface board and option boards are connected to the Terminal board via the Mother board. The Terminal board presents these signals on a two-part connector at the rear of the chassis. Filtering is fitted to each of these connections for EMC. Each Terminal board is fitted with two small pieces of conductive gasket to provide an RF connection to the chassis, this is again for EMC.

SECTION 3: GAS SENSOR MODULE TECHNOLOGY OVERVIEW

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LIST OF FIGURES

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3 GAS SENSOR MODULE TECHNOLOGY OVERVIEW

3.1 Pm 1156 transducer module

3.1.1 Principal of operation

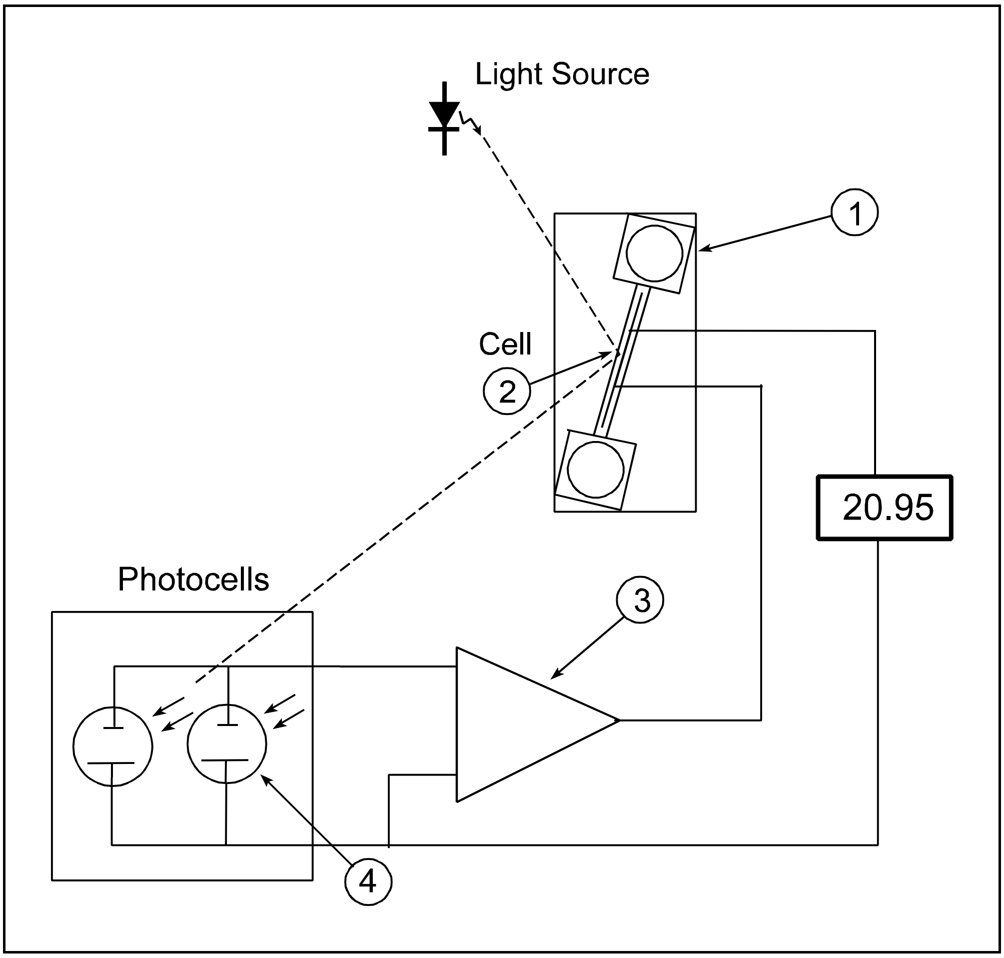

Figure 3.1: 1156A Paramagnetic transducer schematic diagram
Refer to figure 3.1

A physical property which distinguishes oxygen from most other common gases is that it is paramagnetic. This means that molecules of oxygen are weakly attracted into a magnetic field. This paramagnetic behaviour is used within the 1156A transducer to measure the concentration of the oxygen.

Two glass spheres are fixed at both ends of a bar to form a dumb-bell which is sealed (1). The gas under test surrounds the dumb-bell within the sample cell (2). This dumb-bell is suspended in a symmetrical non-uniform magnetic field. The dumb-bell is slightly diamagnetic so that it takes up a position slightly away from the most intense part of the magnetic field. When the surrounding gas contains oxygen then the oxygen molecules will be attracted into the strongest part of the magnetic field. This pushes the dumb-bell further out of the magnetic field due to the relatively stronger force on the paramagnetic oxygen. The magnitude of the torque acting on the dumb-bell will be proportional to the paramagnetism of the surrounding gases and hence proportional to the oxygen

concentration.

The 1156A paramagnetic transducer incorporates a strong rare metal taut-band suspension mechanism onto which is mounted the dumb-bell (1). The "zero" position of the dumb-bell is sensed by a photocell assembly (4) which receives light from a mirror (2) attached to it. The output from the photocell is amplified (3) and fed back to a coil wound around the dumb bell so that the torque acting upon it due to presence of oxygen in the sample is balanced by a restoring torque due to the feedback current in the coil.

The feedback current is direct proportional to the volume magnetic susceptibility of the sample gas and hence, after calibration, to partial pressure of oxygen in the sample. A voltage output is derived which is proportional to the current. Linearity of scale also makes it possible to calibrate the instrument for all ranges by checking at two points only. For example accurate calibration is obtained by using pure nitrogen for zero and air for setting the span at 20.95 %.

All the materials in contact with the sample are highly resistive to aggressive compounds. The internal design of the cell body has a special flow channel to improve the flow characteristics, while the volume is kept to a minimum to provide an excellent response time. The optical carrier (4) has provisions for moving of the photocell mount for setting the initial zero and also incorporates the LED light source and temperature sensing devices.

3.1.2 The Electronics

The control electronics perform all the functions necessary to provide operation of the transducer and to produce an electrical output proportional to the partial pressure of oxygen. Interfacing for inputs and output is via a 16 way IDC connector.

The electronic PCB (01156904) includes the following circuit functions:

1. a constant current source
2. the signal amplification/conditioning circuits
3. the thermometer/signal conditioning circuits
4. the span temperature compensation
5. the output signal conditioning circuits
6. a voltage reference
7. the zero temperature compensation
8. the kick circuit
9. the negative supply generation

A short description of each circuit:

The constant current source provides a constant current for the infrared LED (PL2 pins 1 and 3).

The position of the test body (dumbbell) is detected by a pair of photocells

connected in parallel opposition. The photo-cell assembly can be moved along the path in order to place them in an appropriate position for a null output. This mechanism is termed the coarse mechanical zero

The current output of the photocells which is proportional to the deviation of the test body from the null position is fed into the current amplifier. At the output of the amplifier a phase advance network ensures the stability of the servo system.

The test body assembly includes the feedback coil on the test body, thus completing the servo loop.

The thermometer/signal conditioning circuits include an electronic thermometer placed in close contact with the face of the transducer. The thermometer supplies a current which is proportional to the absolute temperature. This signal is used for zero temperature compensation.

The span temperature compensation relies on a thermistor and a resistance network. It provides temperature compensation over a broad range of operating temperatures.

The output signal conditioning circuits provide temperature compensation and incorporates coarse and fine span adjustment and fine zero adjustment. The output signal is provided at PL1 Pin 10 wrt Pin 9.

The voltage reference generates reference voltages of both positive and negative polarity. These signals are used with the fine zero adjustment and the temperature output circuits. They also provide an offset to the zero temperature compensation circuitry, thus ensuring the compensation signal level at the calibration temperature is zero.

The zero temperature compensation is derived from the thermometer output. The level of compensation is factory set.

The kick circuit is only functional during power up. If the sample gas is pure oxygen and the power to the transducer is lost, some units will deflect to a point where the reflected light beam does not fall onto the photocells. When power is restored the kick circuit supplies an appropriate current in order to restore the feedback control.

The negative supply circuit generates the negative supply rail required by the remaining circuitry.

3.2 Gfx 1210 transducer module

3.2.1 Principles of operation

The Gfx 01210 is a Servomex Infrared Gas Filter Correlation transducer. 4100B versions measure carbon monoxide (CO), carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) over the standard ranges shown below.

TABLE 2.2 GFX MEASURAND AND STANDARD RANGES			
Sensor Type	**Sensitivity**	**Gas**	**Range (vpm)**
1210/701	High	CO	0 - 50
1210/731	High	CO_2	0 - 10
1210/741	High	N_2O	0 - 50
1210/751	High	CH_4	0 - 50

The description which follows uses carbon monoxide as an example only. Everything stated applies equally to the carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) measurements.

Like most pollutant gases carbon monoxide (CO) absorbs electromagnetic energy in the infrared spectrum. The amount of the IR absorbed provides a measurement of the CO in the sample. Sensors utilising a band pass optical filter to select the wavelengths absorbed by CO are well known for the measurement of percentage level CO samples. Their effectiveness for measuring low (vpm) levels of CO have been limited by the following factors.

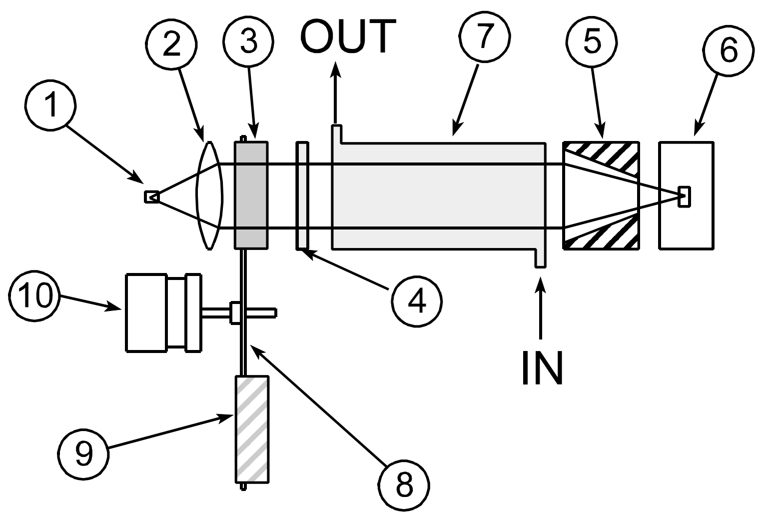

Figure 3.2 Gfx 1210 transducer schematic diagram

1. Cross sensitivity to other IR absorbers.

Other gases in the gas stream (such as H_2O and CO_2) also absorb IR energy at the same energy wavelengths as CO. This results in a cross sensitivity effect.

2. Drift.

Instability in the IR source and detection and contamination of the sample cell result in changes in the transmitted IR energy measured. This baseline instability is observed as drift in the measured CO value.

The gas filter correlation technique resolves the weaknesses inherent in more traditional IR absorption sensors. These weaknesses, including drift and cross sensitivity, are effectively eliminated by the use of gas filled filters. The IR absorption spectrum of CO is not a smooth curve but consists of a number of distinct lines. So while at low resolution the IR spectra of CO and CO_2 (for example) overlap, at high resolution they do not. Band pass optical filters with sufficient resolution are not generally available. Gas filled filters allow the transducer to selectively remove only those IR wavelengths directly associated with CO.

Refer to figure 3.2

An infrared source (1) produces broad band infrared energy. A lens (2) is used to provide a collimated IR beam that passes to the transducer. A band pass IR filter (4) selects only those wavelengths in the IR spectrum that are absorbed by CO.

Two small glass gas filled cells (cuvettes), one containing nitrogen (9) and the other one containing CO (3), are mounted on a wheel (8). A brush less DC motor (10) causes the wheel to rotate. As the wheel rotates the infrared beam alternately goes through the nitrogen filled filter and the CO filled filter. When the nitrogen filter is in position, no absorption takes place and all of the IR energy passes through to the sample gas cell and detector. When the CO filter is in position, absorption takes place and the IR intensity of the wavelengths characteristic to CO is reduced.

The modulated IR beam passes through a gas filled sample cell (7) where some of the IR energy is absorbed. The remaining IR energy passes through a condenser light pipe (5). This concentrates the energy onto a pyrolytic infra red detector (6). This measures the intensity of the IR beam.

The IR radiation that had passed through the nitrogen filter is significantly attenuated when it passes through the sample gas containing CO. The radiation that had passed through the CO filter is not significantly affected by the sample gas containing CO because most of the energy at wavelengths characteristic to CO were already removed by the gas filled filter.

Sample gases containing CO_2 or other IR absorbers attenuate the signal with the nitrogen and CO filled filters equally. Hence they have little effect on the

measurement.

Changes in source intensity or contamination of the sample cell also effect the signals with the nitrogen and CO filled filters equally and again have little effect on the measurement.

The value obtained by rationing the difference between the nitrogen and gas signal with the gas signal is related to the CO gas concentration. Any changes which equally affect both nitrogen and CO signals will be cancelled by this design.

3.2.2 The electronics

The Gfx 1210 consists of four main electronic assemblies:

The Infra Red Detector Pre-amp PCB (01210901)

Refer to circuit diagram 01210/101.

The Infra Red Detector Pre-amp PCB translates IR radiation into an analogue voltage which can be further processed in order to extract the useful information.

IC3, a pyro-electric infra red (P.I.R.) sensor (figure 3.2[6]) responds to changes in infra-red radiation levels falling upon its sensing area. An output signal appears on pin 2 of IC3, which connects to R3 (IC3 load resistor), and a passive high pass filter formed by C3 and R4. C4 provides low pass filtering. The resulting signal is then amplified by part of IC1, (a variable gain amplifier). The gain of this stage can be set between 28 and 128 by adjusting RV1. The amplified signal then passes to the second part of IC1, which is a precision differentiator circuit. Output current is limited by R9, and C13 is for EMC protection.

A stabilized supply for the P.I.R. detector is provided by using the Zener diode D1 in a resistive divider circuit. C1 and C2 provide further filtering of the power supply for the P.I.R. detector.

The Signal Processing PCB (01210902)

Refer to circuit diagram 01210/103.

On the Signal Processing PCB the signal from the pre-amp PCB is sequentially distributed to four sample and hold circuits. The averaged dark signal is subtracted from the averaged signals corresponding to nitrogen and CO. The resulting nitrogen signal is subtracted from the CO signal and is provided together with the CO signal to the Xentra unit in order to work out the CO concentration.

The signal from the pre-amp board passes through a low pass filter LC2 and through R2 to IC5 pin 8, and one section of IC8, which is a unity gain buffer for TP1. This signal is sequentially distributed by IC5 to four averaging circuits

comprising IC6, C24, C25, C26 and C27. These averaged signals are "DNIT" (dark nitrogen), "LNIT" (light nitrogen), "DGAS" (dark gas) and "LGAS" (light gas), which are differentially processed to remove the common mode "dark" signals from "LNIT" and "LGAS". Low pass filtering and gain adjustment is provided by two sections of IC8, and the outputs are $V_{nitrogen}$ and V_{gas}. C5 and C3 provide EMC protection, and these signals are sent to the "MAST" connector. The remaining section of IC8 produces a difference signal from $V_{nitrogen}$ and V_{gas}, named V_{diff} and this signal is sent to the MAST connector through low pass filter LC7.

IC5 is a DPG508A analogue multiplexer and IC6 is a AD704 quad op-amp connected to form two difference amplifiers with high impedance inputs. IC5 samples the light and dark signals for CO and nitrogen while the difference amplifiers subtract the dark signals from the light signals to provide the V_{gas} and $V_{nitrogen}$ signals. R3, C4 and IC8 pin 5, 6 and 7 provide low pass filtering for the output $V_{nitrogen}$.R4, C2 and IC8 pin 1, 2 and 3 provide low pass filtering and a variable gain buffer. SW1 and RV1 provide coarse and fine gain adjustment for transducer calibration. The output V_{gas} is calibrated to be equal with $V_{nitrogen}$ when the sample gas does not contain any CO.

RN4 and IC8 pin 12, 13 and 14 provide a variable gain difference amplifier. The value of R14 (430 ohms) was selected in order to provide a 1 volt for V_{diff} when the sample concentration is 500 ppm CO.
IC8 pin 8, 9 and 10 provides a buffer for the diagnostic output TP1. This signal shows all four sampled and averaged signals superimposed on the input signal received from the pre-amp PCB

The Housekeeping PCB (01210903)

Refer to circuit diagram 01210/103.

The Housekeeping PCB provides the required voltages for the chopper wheel motor and for the IR source. In order to avoid the effects of the ambient temperature on the CO concentration, the chopper box and the signal processing board are kept to a constant temperature of 70˚C. The PID heater control system is located on the housekeeping PCB. On this PCB are also located the digital circuits which provide the logic for the sequential distribution of the four sample and hold circuits.

IC1 forms a P.I.D. chopper box heater control system. The temperature is sensed by a thermistor connected to PL1 pin 18 and 20, which in conjunction with R1 and R2 form a resistive voltage divider. C2, R94 and IC1 pin 1, 2 and 3 are wired in a differentiator configuration in order to produce an output signal proportional with the rate of change of the thermistor resistance. The output signal is summed with the main thermistor signal to produce error rate damping. The sum of these two signals is used as input for the other half of IC1 wired in an integrator configuration. The output of this integrator (pin 7 of IC1) will change as long as the voltage on pin 18 PL1 is different in respect with the reference of 2.5 volts. When the power is switched on the resistance of the thermistor is high and in consequence the voltage on pin 18 PL1 will be lower then 2.5 volts. A

current will flow through R8 which will charge C4 and the integrator output voltage will increase. This will have as an effect, an increase in power applied to the chopper box heaters. Once that the thermistor will see a temperature closed of 65 ˚C, the voltage on pin 18 PL1 will become approximately zero, the integrator output voltage will not increase any more and the power applied to the heaters will remain constant. Any change in the thermistor's resistance will the change the power applied to the heaters in order to keep the chopper box temperature constant.

Transistor TR1 limits the integrator output range and results in faster temperature stabilisation by preventing unnecessary voltage swing after the output transistor is saturated.

The two sections of IC2 are unity gain buffers for the AD590 temperature sensors on the IR detector pre-amp and chopper box.

The ICs 4,5,6 and 7 form a standard configuration for hall effect commutated brush less motors. Passive low pass filters have been added to the Hall inputs to prevent EMC inducing spurious commutation. IC6 is the motor driver IC and IC7 is the phase locked loop motor speed controller. Speed errors are detected and signalled by IC7. IC4, TR4 and IC13 use this error signal to disable the instrument and measurements during incorrect motor operation. The D14 green LED is switched on when the motor is in synchronisation.

The ICs 8, 9, 10, 11, 12, and TR's 2, 3, 5 and 6 form a switched mode supply for the Infra red source. IC10 is a switched mode controller. Passive low pass filters added to the voltage and current sense inputs on IC10 are for EMC suppression. R82, TR5 and TR6 detect and open circuit failure or a malfunction of the switched mode power supply. IC13 sends the fault signal to the MAST connector the event of any errors being signalled. IC11 and IC12 perform voltage sensing and programming and the D11 green LED is used to signal a malfunction of the switched mode power supply.

The switch SW1 is used to change the IR source voltage. For the 1210 transducer SW1 is set to position 5 in order to have a source voltage of 2.0 volts.

The D15 green LED is used to signal that the power supply is on and the D16 green LED is used to signal that the transducer is in working order. A malfunction of the switch mode power supply, a motor which is not in synchronisation or a problem with power supply from Xentra unit will switch off the D16 green LED.

The ICs 14, 15, 16 and 17 provide the digital logic required for the analogue multiplexer from the signal processing PCB IC14 provides a 16 MHz clock for the EPLD (IC16). The synchronisation signal from the optical sensor provides information in respect to the disk position. Inside the EPLD this signal is processed in order to implement the address lines A1 and A0 and an enable signal for the analogue multiplexer. IC15 and IC16 are used as frequency dividers.

IC18, a serial EEPROM circuit is programmed by the Xentra unit and stores the liniarisation information required for the calibration of the 1210 transducer.

The Chopper Box PCB (01210904)

Refer to circuit diagram 01210/104.

The Chopper Box PCB provides the interface between the motor and the housekeeping board. The optical sensor which generates the synchronisation signals from the chopper wheel is also located on this board.

A slotted optical sensor is used to detect slots around an interrupter disc. The signal provided by the optical sensor is used to synchronise the analogue multiplexer. The board also includes the motor interface and a AD590 temperature sensor.

3.3 Zirconia transducer module

3.3.1 Principal of operation

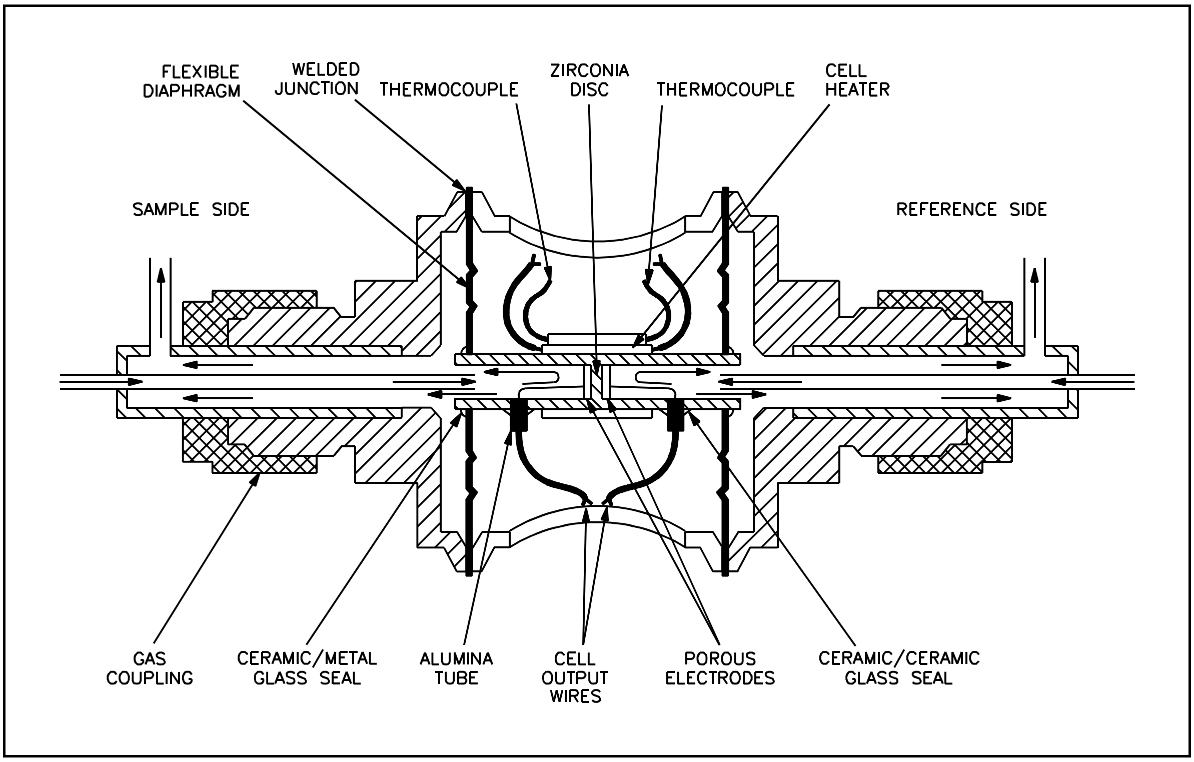

Figure 3.3 Zirconia Cell Cross Section

The Servomex (R) zirconia sensor (Figure 6.3) is manufactured using yttria stabilised zirconia. When this material is heated to a temperature above 600°C it will conduct oxygen ions. The oxygen ion conductivity increases exponentially with temperature. The sensor consists of a disc of yttria stabilised zirconia mounted in a tube of the same material. The faces of the disc are coated with platinum and the assembly is mounted in a small temperature controlled tubular oven.

When the two sides of the disc are exposed to gases containing oxygen, a concentration cell is formed and an electrical output proportional to the logarithm of the ratio of the oxygen concentrations on each side of the disc is obtained. (When the concentration is the same on both sides of the disc the logarithm of the ratio is 0.)

The fact that the oxygen content of air is very constant at 20.95% makes it convenient to use air as the reference gas which is applied to one side of the disc while the sample is applied to the other side.

3.3.2 The Electronics

Functional Destribution

The Board provides the following two key areas of functionality:-
- Cell temperature control
- Cell output amplification.

Operation of these areas of the circuit are described in more detail below.

Cell Temperature Control

The Board provides all of the circuitry necessary to mantain the zirconia cell at its correct operating temperature. Heater power to the cell is derived from the AC MAST power connector and is switched under closed loop control. The circuit incorporates a soft start feature to reduce thermal shock to the cell, and limits power delivered to the cell under fault conditions. These circuits are described in more detail:-

Thermocouple Amplifier

The cell thermocouple connects to terminal block TB1. Copper ground planes run under the thermocouple amplifier IC1 to improve EMC. IC1 contains the cold junction compensation.

The temperature of the thermocouple can be found by measuring the voltage on test point TP1 with respect to TP3 and using the the table from the AD595 data sheet.

If the thermocouple is open circuit or reverse connected IC1 pin 12 is pulled low to inhibit the heater circuit.

The cell temperature is set by RV1 in conjunction with LK2 and LK3. The Zirconia electrode temperature is available for Nernst equation calculations at PL2 pin 12. The temperature error amplifier IC3 pin 14 has an output of 2.2V/C which drives the heater controller.

Variable resistor RV2 in conjunction with LK1 compensates for the temperature difference between the Zirconia electrode and the thermocouple. RV2 is adjusted at the time of test to give the correct cell temperature indication determined by the Nernst equation.

Heater Voltage Measurement

The circuit around IC3 pin 1 rectifies the heater voltage pulses. The polarity of the AC input is detected by IC6 pin 2 and is used to control the sign of the gain of amplifier IC3.

Heater Power Measurement

The positive heater pulses are converted into a current by R30 and then drawn through two base-emitter junctions by IC3 pin 7. The voltage on IC5 pin 3 is applied to two more base-emitter junctions, one of which has a constant bias from R21.

Due to the logarithmic characteristic of the base-emitter junctions, the current drawn into the collector of IC5 pin 5 is proportional to the square of the current in R30. This circuit therefore measures the heater voltage and produces a current proportional to the heater power.

Soft Start

Initially C24 is uncharged, so holding TR3 drain low. The current drawn through R14 limits the initial heater power.

As C24 charges up, the current through R14 drops and the power limit increases.

Heater Driver

The heater demand (current in R12) is subtracted from the heater power (current in IC5 pin 5) and integrated by C25.

When the voltage on IC3 pin 8 drops to zero the comparator IC6 pin 13 goes high to enable another heater pulse.

Zero Crossing Switch

The comparator IC6 pin 14 senses the two AC inputs and pulls low to inhibit heater pulses except when the AC is near a zero crossing point.

Full Cycle Heater Pulses

The comparator IC6 pin 1 has hysteresis to provide a clock to IC10 pin 3 which is connected as a divide by 2. This signal is used to clock IC10 pin 11 on each mains cycle.

Heater Output

Transistor TR2 drives the two triacs which supply a symmetrical voltage to the heater. When the heater is not driven, resistors R18 and R19 pull the heater to ground.

The gain of the heater controller from IC3 pin 14 is approximately 5W/V and the gain from the thermocouple to the heater is approximately 11W/V.

Cell Signal Amplifier

The cell is connected to an instrumentation amplifier IC9 which can be set to a gain of 1 or 10.

The output of the instrumentation amplifier is referenced to IC9 pin 10. This voltage is controlled by IC2 pin 8 which allows the cell offset voltage to be removed by adjusting RV3. An external variable resistor connected to TB1 can also be used to remove the cell offset voltage.

The cell amplifier can be linked to have a bipolar output, where the air point is at zero voltage output. The amplifier can also be linked to have a unipolar output where the air point is set to a positive bias voltage.

The air point reference is available on PL2 pin 13 so that a differential measurement can be made to remove any variation in the bias voltage.

The output buffer can be linked to have a gain of 1 or 2.3.

Installation and Configuration

The Board is mounted using the four corner fixing holes. Signal and power connections are made via the 20 way MAST and the power Mast connectors respectively. Flying leads from the zirconia cell are connected at the terminal block TB1.

Care must be taken in the relative positioning of the Board and the cell. The cell electrode temperature may be as high as 730C under normal operating conditions and this will produce heating of the local environment and radiation. Adequate clearance and/or shielding must be provided to ensure that the Board's temperature ratings are not exceeded.

WARNING

The cell temperature may reach approximately 1000C under certain fault conditions. Installation must allow for this.

The Board contains sensitive circuitry that may be affected by RFI. The design of enclosure and the method of mounting must provide the degree of protection necessary to meet the required EMC performance.

Configuration information is documented in the specification.

NOTES

SECTION 4: SPARES LIST

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4 SPARES LIST

PART NUMBER	DESCRIPTION	COMMENTS
S07000902	ZIRCONIA HOUSEKEEPING PCB	(Figure 6.10 [11])
S0703000	ZIRCONIA SENSOR	(Figure 6.10 [6])
S0704000	ZIRCONIA SENSOR, LOW ACTIVITY	(Figure 6.10 [6])
S1156A000	PARAMAGNETIC TRANSDUCER	(Figure 6.14 [17])
S1166901	PRESSURE TRANSMITTER PCB	(Figure 6.14 [13])
S1200923	SCRUBBER ASSEMBLY	(Figure 6.19 [5])
S1210501	KIT SCRUBBER SACHET	(Figure 6.17 [34]
S1210701	GFX TRANSDUCER - CO	See section 6.30
S1210731	GFX TRANSDUCER - CO_2	See section 6.30
S1210741	GFX TRANSDUCER - N_2O	See section 6.30
S1210751	GFX TRANSDUCER - CH_4	See section 6.30
S1210901	KIT, DET. PRE-AMP ASSEMBLY	See section 6.37
S1210902	KIT, SIGNAL P.C.B.	See section 6.40
S1210903	KIT, HOUSEKEEPING P.C.B.	See section 6.39
S1210904	KIT, CHOPPER BOX ASSEMBLY	See section 6.38
S1210923	KIT, I.R. SOURCE	See section 6.31
S1210996	KIT, 1210 FUSES	
S1210997	KIT, OPTICAL WINDOWS	See section 6.35
S1210998	KIT, OPTICAL MIRROR	See section 6.34
S1210999	KIT, MOTOR ASSEMBLY	See section 6.32
S2000902A	PROCESSOR BOARD	(Figure 6.4 [6]) Does not include firmware
S2000906A	2*MA + 2*RELAY PCB	(Figure 6.4 [2,3,4])
S2000924	SENSOR INTERFACE PCB	(Figure 6.4 [7])
S4000423	CALIBRATION MANIFOLD	Supplied complete
S4000651F	4000 SPARE SOFTWARE	See section 7

S4000901	MOTHERBOARD 3 OPTION	(Figure 6.9 [9])
S4000903	KEYPAD PCB	(Figure 6.2 [21])
S4000904	TERMINAL BOARD	(Figure 6.9 [6])
S4000907	EXT. AUTOCAL P.C.B ASSY	
S4000911	MOTHERBOARD 1 OPTION	(Figure 6.9 [9])
S4000924	MULTIPLEXER PCB, 4 TX	(Figure 6.4 [1])
S4000932	DISPLAY + RIBBON ASSY	(Figure 6.2 [24]) Includes lamp.
S4000933	KIT, KEYPAD RIBBON CABLE	(Figure 6.3 [2]) includes ribbon cable clamps [9] and grommet [7]
S4000934	RIBBON CABLE ASSY, MODULE	
S4000935	MODULE POWER CABLE ASSY	
S4000936	MAINS CABLE FORM ASSY	(Figure 6.4 [9,11])
S4000974	KIT, SOLENOID VALVE	
S4000975B	VITON TUBING REFURB. KIT	Includes fittings and adaptors
S4000976	KIT, FEET TIP UP, GREY	four feet with fixing screws
S4000977	KIT, FUSE PCB	Includes : 5 off ’T’ 500 mA for F2 on rear of chassis 20 off 5A PCB fuses (Figure 6.8 [2]) for F1 to F8 on Multiplexer board.
S4000978	KIT, FUSE MAINS 170-264V	10 off 3.15A 20mm ’T’ HBC
S4000979	KIT, FUSE MAINS 85-132V	10 off 5.0A 20mm ’T’ HBC
S4000980	KIT, FRONT FASCIA ASSY	(Figure 6.2 [29]) Includes Window and gasket already installed, flowmeter covers and blanks, labels and sample filter blank with adhesive
S4000981	0.5-5L FLOWMETER	(Figure 6.2 [9,10]) Includes ’o’ rings
S4000982	50-500mL FLOWMETER	(Figure 6.2 [9,10]) Includes ’o’ rings
S4000983	KIT, FAN REPLACEMENT	Use for external (Figure 6.6 [1]) or internal fan (Figure 6.7 [2])
S4000984	RACK MOUNT KIT,SHORT CHASSIS	See operators manual
S4000985	RACK MOUNT KIT, LONG CHASSIS	See operators manual

S4000986	KIT, SOCKET 14W SIGNAL	See operators manual
S4000987	KIT, FINE FILTER CAP	(Figure 6.2 [32]) Includes ’o’ ring
S4000988	KIT, FILTER ELEMENTS 6µ	(Figure 6.2 [33])
S4000990	0.5-2.5L FLOWMETER	(Figure 6.2 [9,10] Includes ‘o’ rings)
S4100902	PARAMAGNETIC MODULE HEATER PLATE	(Figure 6.14 [19])
S4100924	RESTRICTIVE T ASSEMBLY (ZR)	(Figure 6.11 [1])
S4100925	RESTRICTIVE T ASSEMBLY (GFX)	(Figure 6.22 [4])
S4100993	ZIRCONIA GAS SENSOR MODULE 703 CELL	(Figure 6.10)
S4100994	ZIRCONIA GAS SENSOR MODULE 704 CELL	(Figure 6.10)
S4100995	PURITY PARAMAGNETIC SENSOR MODULE, TEMP. CONTROLLED WITH PRESSURE SENSOR.	(Figure 6.14)
S4100996	CONTROL PARAMAGNETIC GAS SENSOR MODULE,	(Figure 6.15)
00700922	INLET PIPE ASSY, ZIRCONIA CELL	(Figure 6.10) [4]
01131434	STUD COUPLING MOD 1/8"BSPTM	
04000934B	RIBBON CABLE ASSY 550MM	
04000937D	1156 RIBBON CABLE 750MM	
04100002B	4100 SERVICE MANUAL	
04100003B	QUICKSTART MANUAL (ENG)	
04100013B	QUICKSTART MANUAL (FRENCH)	
04100023B	QUICKSTART MANUAL (GERMAN)	
04100408	PIPE: P.D. BYPASS OUTLET	
04100431	PIPE: ZR MODULE 1 INLET	See section 6.21
04100432	PIPE: ZR MODULE 2 INLET	See section 6.21
04100433	PIPE: ZR MODULE 3 INLET	See section 6.21
04100434	PIPE: ZR MODULE 4 INLET	See section 6.21
04100435	INLET TUBE, GFX MODULE 1	See section 6.42

04100436	INLET TUBE, GFX MODULE 3	See section 6.42
04100437	OUTLET TUBE, GFX	
2322-1020	EMC CONDUCTIVE GASKET	(Figure 6.3 [1]) or (Figure 6.2 [31])
2344-0027	COUPLING 1/8"OD (F) SS SWA	
2377-3831	EXTERNAL STAINLESS STEEL FILTER UNIT, COMPLETE	See section 2.2.16
2377-3848	SPARE ELEMENT FOR ABOVE	
2383-1638	RESTRICTOR 0.010mm (CREAM)	
2383-1676	RESTRICTOR 0.025mm (BROWN)	
2388-1981	FILTER ELEMENT, FAN	(Figure 6.6 [4])
2517-1527	RIBBON CABLE CLAMP	(Figure 6.3 [9])
2527-3041	MODULE POWER CABLE 7 WAY	
2822-8019	INVERTOR 24 VDC TO 600 V	(Figure 6.2 [41])
3912-8010	KEYMAT MOULDING	(Figure 6.2 [22])
3951-3755	SIDE TRIM LABEL	(Figure 6.1 [4])
4911-6034	SWITCHED MODE POWER SUPPLY	(Figure 6.4 [19])
4961-1159	TRANSFORMER 4 TX	(Figure 6.4 [17]) Includes rubber mat
4961-1166	TRANSFORMER 2 TX	(Figure 6.4 [17]) Includes rubber mat

SECTION 5: FAULT FINDING

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5 FAULT FINDING

5.1 Introduction

This section is categorised according to the component on which the fault is observed and the possible observed symptoms. Under each 'Symptom' heading are listed faults which would cause the symptoms. For each of the faults listed there are some checks to determine the nature of the fault. The fault symptoms listed are categorised into groups relating to either the core instrument chassis assembly, or the individual transducers, to which they apply. Information regarding faults on the different instrument components are to be found in the following sections.

5.2 Xentra 4000 chassis
5.3 Paramagnetic O_2 Purity transducer
5.4 Paramagnetic O_2 Control transducer
5.5 Zirconia transducer
5.6 Gfx 1210 transducer

Diagnostic readings available through the user interface give raw readings from transducer modules. This provides valuable information for fault finding. Instructions on displaying this information are given in section 1.11. The instrument software also maintains a history log of the previous 40 faults and calibrations. Instructions for displaying this information are given in sections 1.9 and 1.10.

5.2 Xentra chassis faults

This section of the manual covers likely fault symptoms associated with the Xentra 4000 core chassis assembly rather than the individual transducers fitted within it. The faults are categorised by the observed symptoms.

5.2.1 Fault messages

Table 5.1 lists the fault messages that are generated by the instrument regarding the core chassis assembly. These are stored within the fault history log (see also section 1.9).

Table 5.1 Chassis fault messages

Fault message	Possible causes	Remedial action
BAD REFERENCE	Reference voltage incorrect	Check / replace sensor interface PCB and/or multiplexer PCB.

5.2.2 Display not illuminated

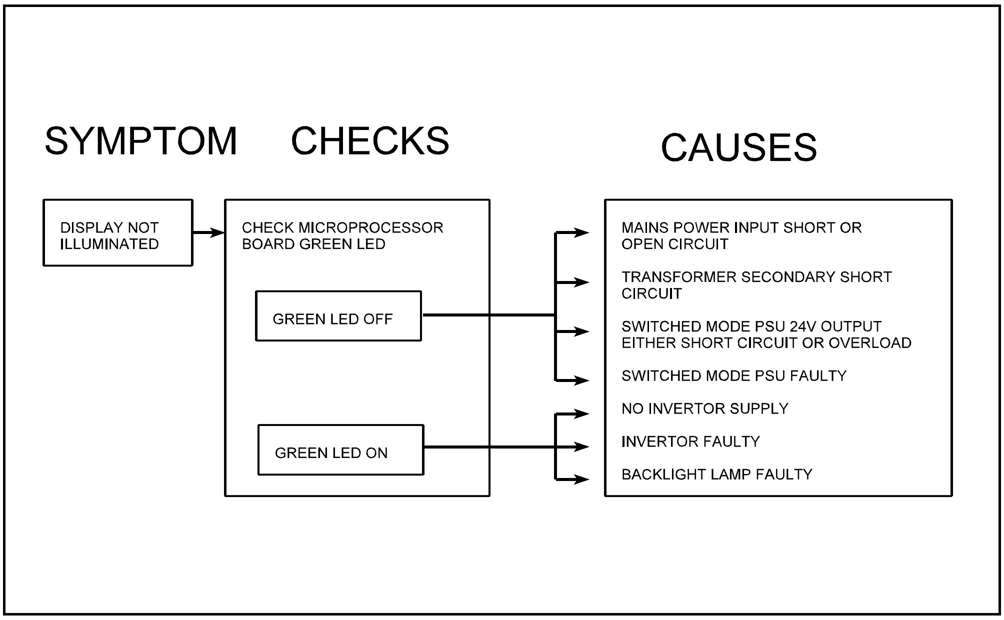

Figure 5.1 Display not illuminated fault tree

Figure 5.1 shows a tree of possible fault causes that would result in the display being blank.

The display lamp runs off the 24V supply from the switched mode power supply and the Microprocessor board runs off the 5V supply. Validity of the supply voltages is assessed by the test points located on the multiplexer PCB.

The green LED on the processor PCB also indicates that the 5V rail of the switched mode power supply is intact. Two different sets of causes are identified depending on whether the green LED on the processor PCB is on or not.

Mains power input short/open circuit

Measurements and diagnosis:

Disconnect the instrument from the mains power source. Ensure that the analyser power switch is in the on position. Check the resistance between Live and Neutral pins on the mains power supply cord. The expected resistance depends on the mains voltage selection and should be within the following ranges:-

85V to 132 V setting	$\leq$ 3.5Ω
170V to 264V setting	$\leq$ 14Ω

The resistance seen is that of the transformer primary windings connected in either series or parallel. The switched mode power supply will appear open circuit.

Check the resistance from Line to Earth and from Neutral to Earth using a suitable isolation tester. These resistances should be greater than 1 MΩ. If the earth leakage resistance is less than 1 MΩ determine where the fault lies by disconnecting the switched mode power supply, transformer and mains cable form (including IEC connector) until the fault is rectified.

Check the fuse F2 on the rear panel of the chassis and replace it if necessary. Check the fuse in the mains power cord and replace it if necessary. Ensure that the mains voltage selector is set correctly and that the fuse is located in the correct side of the fuse holder (see operators manual). Repeat the mains power input resistance tests, as necessary, following any corrective actions.

If the input resistance tests now show a short circuit then determine whether the short lies on the switched mode power supply, the transformer or the mains cable form (including IEC connector). This is accomplished by disconnecting each in turn until the short circuit is removed.

If the mains power input resistance checks still show an open circuit then check the continuity through the mains power connector, mains cable form, Mother board and transformer. Replace any faulty components located in order to achieve the correct mains input resistance.

Transformer secondary short circuit

Measurements and diagnosis:

Power up the analyser and check that the analyser is now operational. If either fuse has blown then disconnect the transformer secondaries and try again. If the instrument power up is now OK then trace the short circuit.

24V rail shorted/overloaded

Measurements and diagnosis:

Check the 5V and 24V rail supplies using the test points on the multiplexer PCB.

The rail voltages should be as follows:-

TP08 wrt TP01	-24Vdc ± 2V
TP05 wrt TP01	+5.05Vdc ± 0.25V

If the 24V rail is overloaded or short circuit then all the supplies will be shut down. If this voltage is outside of this range then replace the switched mode power supply.

No power supply to the invertor PCB

Measurements and diagnosis:

Remove the instrument fascia and check the voltage at the input to the invertor PCB.

pin 2 wrt pin 1 -24Vdc ± 2V

If this voltage is not present then check the continuity of the keypad ribbon cable and replace if necessary.

Invertor supply faulty

Measurements and diagnosis:

Check the output voltage of the invertor (pin 3 wrt pin 5). Note that this is a sinusoidal waveform at 35 kHz, ensure that the test equipment is suitably specified.

Nominal open circuit voltage	1 KV
Normal operating voltage	300V

If the output voltage is not present then replace the invertor PCB or the entire keypad PCB.

LCD back light lamp faulty

Measurements and diagnosis:

Check the output voltage from the invertor PCB (pin 3 wrt pin 5). If this voltage > 500 V then check the back light connections and / or replace LCD.

5.2.3 Display illuminated but no text

Switched mode power supply faulty

Measurements and diagnosis:

Check the power supply rail voltages using the test points on the multiplexer PCB. The following test points on the Multiplexer PCB should be used.

TP05 wrt TP01 +5.05V ± 0.25V

If supply voltage is low or is not present then disconnect the following units in order to determine whether the 5V rail is being pulled down:
Ensure that the instrument is switched off before connecting or disconnecting PCB's.

i) Gas sensor modules
ii) Option boards
iii) Sensor interface board
iv) Keypad ribbon cable
v) Microprocessor board
vi) Multiplexer board (by elimination of other possible causes)

Microprocessor PCB faulty

Measurements and diagnosis:

Check that the red LED's, D2 and D3, on the Microprocessor PCB are initially illuminated after power up and are then extinguished after approximately 5 seconds. If LED's are not extinguished then replace the microprocessor PCB. **Note** : Replacing the microprocessor PCB will require reconfiguration of the analyser; Refer to section 7.2.

Keypad ribbon cable faulty

Measurements and diagnosis:

Check the continuity of keypad ribbon cable. Replace the ribbon cable if necessary.

5.2.4 System failure bad exec message

Re-start the analyser by switching the power off momentarily. If the fault persists then replace the Microprocessor PCB. **Note** : Replacing the microprocessor PCB will require reconfiguration of the analyser; Refer to section 7.2.

5.2.5 Incorrect or no response to key presses

The Microprocessor has a matrix of digital inputs (4 off X inputs and 3 off Y inputs), each key is connected across one X input and one Y input. See Keypad PCB circuit diagram 04000/103. The Microprocessor board scans the inputs to determine which key is pressed.

Measurements and diagnosis:

Check continuity between keypad switches and microprocessor board.

Switch off power and remove option cards 3 and 4 (figure 6.4 [4,5]) to allow access to PL1 on the microprocessor board, this is the plug which connects to the Mother board. A pressed key should give a resistance of less than 100Ω, an unpressed key should give a resistance of greater than 10KΩ. Table 5.2 gives the pin numbers for PL1 and the key to which they correspond. With the instrument power switched off check that the correct resistance is seen across each set of pins when the corresponding key is pressed and not pressed. Row ’c’ is the top row of pins and pin 1 is on the right when viewing the component side.

If the correct resistances are seen for all keys then the fault is probably located on the Microprocessor PCB. If the correct resistances are not seen the fault may lie with the Keypad rubber mat, the Keypad PCB or the ribbon cable.

Check continuity of keypad ribbon cable and replace if necessary.

Table 5.2 Keypad pin connection details	
Key name(matrix)	**02000/902 PL1 row 'c' pin numbers.**
MEASURE (X3,Y4)	25,22
MENU (X3,Y3)	25,21
EDIT (X2,Y1)	24,19
QUIT (X3,Y1)	25,19
ENTER (X1,Y2)	23,20
LEFT (X3,Y2)	25,20
RIGHT (X1,Y1)	23,19
UP (X1,Y3)	23,21
DOWN (X1,Y4)	23,22

Check whether the contact pills on the Keypad rubber mat or the corresponding gold flashed contacts on the Keypad PCB are contaminated. Replace Keypad rubber mat or PCB as necessary or clean with a lint free cloth soaked in either MEK or acetone. Do not soak the Keypad rubber mat or PCB in either of these solvents. Do not touch the contact pills on the rubber mat or the gold flashed contacts on the keypad PCB by hand.

5.2.6 Output alarm relays do not operate

Symptoms:

Alarm output relays do not operate.

Measurements and Diagnosis:

a. Check that the relay assignment are correctly configured and enabled within the instrument software. Correct where necessary and re-validate instrument performance.

b. Check that interconnecting wiring is correctly installed within the screw terminal block within the external two part connectors. This is conveniently accomplished by removing the connector and checking operation at the connector pins. Correct where necessary and re-validate instrument performance.

c. Ensure that the signal interface board, optional output boards, and associated terminal boards are correctly located within their connectors on the mother board. Correct where necessary and re-validate instrument performance.

d. If more than one output board is fitted and all outputs are not working then replace the microprocessor PCB and re-validate instrument performance.

e. If there is only one output board (the Sensor Interface PCB) or the fault lies within the first output board then replace the Sensor Interface PCB and/or its associated terminal PCB and re-validate instrument performance.

f. If the fault is located on one of the remaining optional output boards then replace the faulty output PCB and/or its associated terminal board and re-validate instrument performance.

g. Replace the microprocessor PCB and re-validate instrument performance. **Note** : Replacing the microprocessor PCB will require reconfiguration of the analyser; Refer to section 7.2.

h. Check electrical continuity between the output boards and the associated terminal boards via the instrument motherboard connectors. Replace the mother board PCB if this is faulty and re-validate instrument performance.

i. Replace the motherboard PCB and re-validate instrument performance.

5.2.7 Analogue output readings not present

Symptoms:

Analogue output readings not working.

Measurements and Diagnosis:

a. Check that the analogue output channel assignment are correctly configured and enabled within the instrument software. Correct where necessary and re-validate instrument performance.

b. Check that interconnecting wiring is correctly installed within the screw terminal block within the external two part connectors. This is conveniently accomplished by removing the connector and checking operation at the connector pins. Correct where necessary and re-validate instrument performance.

c. Ensure that the signal interface board, optional output boards, and associated terminal boards are correctly located within their connectors on the mother board. Correct where necessary and re-validate instrument performance.

d. If more than one output board is fitted and all outputs are not working then replace the microprocessor PCB and re-validate instrument performance.

e. If the instrument has only one output board (the Sensor Interface PCB) or the fault lies within the first output board then replace the Sensor Interface PCB and/or its associated terminal PCB and re-validate instrument performance.

f. If the fault is located on one of the remaining optional output boards then replace the faulty output PCB and/or its associated terminal board and re-validate instrument performance.

g. Replace the microprocessor PCB and re-validate instrument performance. **Note** : Replacing the microprocessor PCB will require reconfiguration of the analyser; Refer to section 7.2.

h. Check electrical continuity between the output boards and the associated terminal boards via the instrument motherboard connectors. Replace the mother board PCB if this is faulty and re-validate instrument performance.

i. Replace the motherboard PCB and re-validate instrument performance.

5.2.8 Analogue output readings not accurate

Symptoms:

Analogue output readings inaccurate or do not follow required composition changes.

Measurements and Diagnosis:

a. Check that the analogue output channel assignments are correctly configured and enabled within the instrument software. Correct where necessary and re-validate instrument performance.

b. Check that interconnecting wiring is correctly installed within the screw terminal block within the external two part connectors. This is conveniently accomplished by removing the connector and checking operation at the connector pins. Correct where necessary and re-validate instrument performance.

c. Ensure that the signal interface board, optional output boards, and associated terminal boards are correctly located within their connectors on the mother board. Correct where necessary and re-validate instrument performance.

d. If there is only one output board (the Sensor Interface PCB) or the fault lies within the first output board then replace the Sensor Interface PCB and/or its associated terminal PCB and re-validate instrument performance.

e. If the fault is located on one of the remaining optional output boards then replace the faulty output PCB and/or its associated terminal board and re-validate instrument performance.

f. Replace the microprocessor PCB and re-validate instrument performance. **Note** : Replacing the microprocessor PCB will require reconfiguration of the analyser; Refer to section 7.2.

g. Check electrical continuity between the output boards and the associated terminal boards via the instrument motherboard connectors. Replace the mother board PCB if this is faulty and re-validate instrument performance.

h. Replace the motherboard PCB and re-validate instrument performance.

5.2.9 No response to range change input

Symptoms:

Analogue output ranges do not change when range 2 is selected via external contact closure.

Measurements and Diagnosis:

a. Check that the analogue output assignments are correctly configured and enabled within the instrument software. Check that the range 1 and range 2 assignment ranges are not identical. Correct where necessary and re-validate instrument performance.
b. Check that connecting wiring is correctly installed to pins within the screw terminal block fitted to connector PL5 pins 13 and 14. Correct where necessary and re-validate instrument performance.
c. Replace the Sensor Interface PCB and re-validate the instrument performance.
d. Replace the microprocessor PCB and re-validate instrument performance. **Note** : Replacing the microprocessor PCB will require reconfiguration of the analyser; Refer to section 7.2.
e. Replace the motherboard PCB and re-validate instrument performance.

5.2.10 No response to auto cal initiate input

Symptoms:

Autocalibration not activated by closure of external auto cal initiate contacts.

Measurements and Diagnosis:

a. Check that the autocalibration configuration is correctly configured and enabled within the instrument software. Check that the 'S' number (feature 11) within the instrument ID is set to 1 or 2. Correct where necessary and re-validate instrument performance.
b. Check that connecting wiring is correctly installed to pins within the screw terminal block fitted to connector PL5 pins 11 and 12. Manually short circuit pins 11 and 12 for at least 5 seconds while the instrument is in the measurement display to initiate an autocalibration. Correct where necessary and re-validate instrument performance.
c. Replace the Sensor Interface PCB and re-validate the instrument performance.
d. Replace the microprocessor PCB and re-validate instrument performance. **Note** : Replacing the microprocessor PCB will require reconfiguration of the analyser; Refer to section 7.2.
e. Replace the motherboard PCB and re-validate instrument performance.

5.2.11 Analyser does not keep correct time/date

Symptoms:

Time and/or date requires frequent correction or does not work.

Measurements and Diagnosis:

a. Check that internal clock has been correctly set and the instrument has not been powered down for period exceeding two days.
b. Replace microprocessor PCB and re-validate instrument performance. **Note** : Replacing the microprocessor PCB will require reconfiguration of the analyser; Refer to section 7.2.

5.2.12 Calibration gases are not introduced via solenoid valves

Symptoms:

Autocalibration failure.
Autocalibration valves do not operate.

Measurements and Diagnosis:

a. Check that calibration gases are correctly attached to inlet ports.
b. Manually initiate an instrument autocalibration and listen for an audible click as the valve actuator operates. If a click is heard then inspect the manifold block and valve seals for contamination. Correct and re-validate instrument operation.
c. If an audible click is not heard unplug the solenoid valves from connector PL22 and PL23 on the motherboard and verify that the 24VDC operating voltage is present while each valve is being activated. If the 24VDC supply is present, then the solenoid valve is faulty and should be replaced. Ensure that the connectors are correctly replaced onto PL22 and PL23 as indicated by the motherboard markings.
d. The 24VDC supply for the solenoid valves is sourced on the Multiplexer PCB. With the solenoid valves unplugged then check that the 24VDC rail is available on TP08 (wrt TP01) on the multiplexer PCB. If the rail voltage is present then replace the multiplexer PCB and re-validate the instrument performance.
e. Replace the sensor interface PCB and re-validate the instrument performance.
f. Replace the microprocessor PCB and re-validate performance. **Note** : Replacing the microprocessor PCB will require reconfiguration of the analyser; Refer to section 7.2.
g. Replace the motherboard PCB and re-validate performance.

5.2.13 Overheating

Symptoms:

Internal temperature of instrument is too high.

Measurements and Diagnosis:

a. Check that the ambient operating temperature does not exceed 40°C.
b. Check that the external fan filters are clean and the cooling fan operates. Replace where necessary and re-validate instrument performance.
c. If an internal cooling fan is provided then check that this is operational.
d. Check that the ventilation holes are not obstructed.
e. Check that the internal transducers are operating at their correct temperatures and are not overheating.

5.3 Paramagnetic O_2 purity transducer faults

This section of the manual covers likely fault symptoms associated with the Pm O_2 purity transducer assembly. The faults are categorised by the observed symptoms.

5.3.1 Diagnostic measurements

Table 5.3 shows a list of the diagnostic signals available for the Pm O_2 purity transducer assembly.

Table 5.3 Diagnostic signals for the Pm O_2 purity transducer

Diagnostic	Description	Typical level	Range
CELL EMF	Cell output volts	0-1 V	-0.1 to 1.2 V
CELL TEMP	Cell temperature	55 °C	50 to 55 °C
CELL PRESSURE	Cell sample pressure	15 psia	5 to 25 psia

Paramagnetic cell output

This is the raw output and is not pressure compensated or calibrated. The signal is scaled approximately as follows: 0V corresponds to 0% oxygen and 1V corresponds to 100% oxygen. A XXX fault is indicated if the raw cell output results in an A-D conversion of zero or full scale, this corresponds to a cell output of -0.25 V and 1.31V respectively.

Pm O_2 purity cell temperature

The oven which houses the paramagnetic cell runs at 55°C. Errors in the indicated temperature mean that the displayed temperature will lie between 50°C and 55°C. A XXX fault is indicated if the indicated cell temperature is above 70°C or below 50°C after 2 hours from switching on.

Pm O_2 purity sample pressure

The sample pressure is displayed in psia. A fault is indicated if the sample pressure falls below 5 psia (35 kPaa) or the resultant A - D conversion is full scale, this corresponds to approximately 26.2 psia (181 kPaa).

5.3.2 Fault messages

Table 5.4 shows a list of the indicated fault condition for the Pm O_2 purity transducer assembly.

Table 5.4 Fault messages for the Pm O_2 purity transducer		
Fault message	**Fault history message**	**Remedial action**
CELL TEMP LOW	CELL T LO	Check fuses F1 to F8 on multiplexer PCB. Check /replace paramagnetic cell heater assembly or transducer.
CELL TEMP HIGH	CELL T HI	Check/replace paramagnetic heater assembly and/or paramagnetic transducer.
CELL VOLTS LOW	CELL V LO	Check/replace paramagnetic transducer.
CELL VOLTS HIGH	CELL V HI	
PRESSURE LOW	CELL P LO	Check voltage (TP03 with respect to TP01) on multiplexer PCB. Check/replace pressure transducer assembly (Figure 6.14[15]).
PRESSURE HIGH	CELL P HI	Check sample outlet is not obstructed. Check/replace pressure transducer assembly (figure 6.14[15]).
LOW CAL OUTSIDE TOL	LO TOL	Check 'USER SET' limits. Check calibration gases. Check operation of auto-calibration solenoid valves. Attempt manual calibration check.
HIGH CAL OUTSIDE TOL	HI TOL	
LOW CAL OUTSIDE RANGE	LO RANGE	
HIGH CAL OUTSIDE RANGE	HI RANGE	
SAMPLE FLOW LOW	LOW FLOW	Check sample gas pressures and flow. Check sample needle valves. Check filter and auto-calibration solenoid valves.

5.3.3 Transducer faults

Symptoms:

No response from transducer with changing gas composition.
Transducer producing invalid results.

Measurements and Diagnosis:

a. Verify continuity of interconnecting wiring between the measurement cell and the house keeping PCB and between the transducer and the Multiplexer PCB. Correct or replace where necessary and verify instrument performance.

b. Verify the power supply 5V rail voltage on the multiplexer PCB.

TP05 wrt TP01 +5.05V ± 0.25V

If the supply voltage is low or is not present then disconnect the following units in order to determine whether the 5V rail is being pulled down or the switched mode PSU is faulty:
Ensure that the instrument is switched off before connecting or disconnecting PCB assemblies.

Gas sensor modules.
Option boards.
Sensor interface boards.
Keypad ribbon cable.
Microprocessor board.
Multiplexer board (by elimination of other possible causes).

Correct or replace where necessary and verify instrument performance.

c. Check the following output voltages on connector PL1 on the transducer house keeping PCB.

Pin 12	Cell temperature.
Pin 10	Cell output EMF.

Verify that these signals reflect the input gas composition when nitrogen and air gas samples are applied to the inlet port. If the output voltages are incorrect then replace the transducer and re-verify the transducer performance.

d. Verify that the instrument diagnostic display for the transducer output EMF and temperature conform with those measured on pins 10 and 12 on connector PL1 on the transducer house keeping PCB. If these are incorrect then the fault may lie within either the Multiplexer PCB or the Signal Interface PCB. Correct or replace where necessary and verify instrument performance.

e. If none of the above tests have identified a problem then replace the transducer and verify instrument performance.

5.3.4 Measurement faults

Symptoms:

Unable to perform zero calibration.
Unable to perform span calibration.
Calibration failure fault indicated.
Low instrument sensitivity.
Poor instrument accuracy.

Measurements and Diagnosis:

a. Verify contents of the calibration gas samples have been correctly entered into the instrument software and that calibration gases are correctly connected. Check that calibration gas supply is not exhausted. Increase the calibration tolerance if necessary. Correct or replace where necessary and perform instrument calibration to verify performance.

b. Check that the concentration of the calibration sample corresponds with the concentration specified in the autocalibration configuration. Perform an ONE CYCLE autocalibration to clear the fault.

c. Verify correct operation of autocalibration valves if fitted. Perform a leak test to verify cross seat leakages. Correct fault in accordance with section 5.2.12 if necessary. Correct or replace where necessary and perform instrument calibration to verify performance.

d. Verify that there are no leaks in the internal pipe work and that flow meters operate correctly (if fitted). Correct or replace where necessary and perform instrument calibration to verify performance.

e. Verify that there are no blockages in the sample filter (if fitted) and internal flow restrictors. Correct or replace where necessary and perform instrument calibration to verify performance.

f. Verify that the instrument exhaust port is not restricted and that the instrument is not being pressurised above ambient pressure. Correct or replace where necessary and perform instrument calibration to verify performance.

g. Check the cell output voltage using pins 9 and 10 on connector PL1 on the transducer house keeping PCB (see drawing 01156/102). Check that the output varies from 0V to 0.21V as a zero and air sample are applied to the sample input port for the specific gas stream. Correct or replace transducer and PCB where necessary and re-verify performance.

h. Verify continuity of interconnecting wiring from the transducer cell to the transducer house keeping PCB and from the transducer to the MULTIPLEXER PCB. Correct or replace where necessary and re-verify instrument performance.

i. Check the cell output shown in the instrument diagnostics display matches the output voltage given on pins 9 and 10 on connector PL1 of the transducer housekeeping PCB (see also drawing 01156/102). Fault is likely to be either the Sensor Interface PCB or the Multiplexer PCB. Identify and replace the faulty PCB where necessary and re-verify performance.

5.3.5 Stability faults

Symptoms:

Noisy reading.
Reading drifts.
Instrument requires frequent re-calibration.

Measurements and Diagnosis:

a. Verify that the sample flow rate through the transducer is in the range 100-250 ml/min and is stable. Correct or replace where necessary and re-verify instrument performance.

b. Perform a leak test to verify that the internal pipe work is free from leaks. Correct or replace where necessary and re-verify instrument performance.

CAUTION
The paramagnetic transducer should not be pressurised above 10 psig (70 kPag). When leak testing the pipework care should be taken that the paramagnetic cell is pressurised and depressurised slowly. Failure to do this may result in damage to the cell.

c. Verify that the sample filter (if fitted) is not blocked and that there are no obstructions within the instrument vent line. Correct or replace where necessary and re-verify instrument performance.

d. Verify that the instrument is free from condensed water. Correct or

replace where necessary and re-verify instrument performance.

e. Verify continuity of interconnecting wiring from the transducer cell to the transducer house keeping PCB and from the transducer to the MULTIPLEXER PCB. Correct or replace where necessary and re-verify instrument performance.

f. Unplug the transducer from the MULTIPLEXER PCB and verify that the instrument is now stable. If not then the fault is likely to lie with the Sensor Interface PCB or MULTIPLEXER PCB. Identify and replace faulty PCB's where necessary and re-verify instrument performance.

g. Check instrument sensitivity by performing a zero and span calibration. If the instrument sensitivity is low then perform the instrument measurement fault checks in section 5.3.4.

h. If none of these checks rectify the problem then replace the transducer and verify performance.

5.3.6 Flow faults

Symptoms:

Slow instrument response.
Drift.
Noise.
Flow sensitive results.

Measurement and Diagnosis:

a. Verify that the sample flow rate through the transducer is in the range 100-250 ml/min and is stable. Verify that any flow stability problems encountered are not produced by any sample conditioning system used prior to sample entry into the instrument. Particular attention should be made to knock out pots, sample pumps, chillers and filters. Correct or replace where necessary and re-verify instrument performance.

b. By performing a leak test verify that the internal pipe work within the instrument is leak tight. Pay particular attention to flow meter leakages if these are fitted. Correct or replace where necessary and re-verify instrument performance.

CAUTION

The paramagnetic transducer should not be pressurised above 10 psig (70 kPag). When leak testing the pipework care should be taken that the paramagnetic cell is pressurised and depressurised slowly. Failure to do this may result in damage to the cell.

c. Verify that the optional sample filter (if fitted) is clean and not blocked. Correct or replace where necessary and re-verify instrument performance.

d. Verify that the orifice flow restrictors within the instrument are not blocked. Correct or replace where necessary and re-verify instrument performance.

e. Verify that the pipe work attached to the instrument vent is not restrictive and resulting in pressurisation of the sample cell. Correct or replace where necessary and re-verify instrument performance.

f. Verify that the transducer is not contaminated (particularly with condensed water). Correct or replace transducer if necessary and re-verify instrument performance.

g. Replace transducer and verify that the problem is corrected.

5.3.7 Inaccurate pressure compensation

Symptoms:

Incorrect cell pressure indication.
Analyser output sensitive to ambient pressure changes.
Drift.
Flow sensitive results.

Measurement and Diagnosis:

a. Check that the pressure sensor offset has been correctly calibrated. Perform a pressure offset calibration in accordance with the instructions in the Xentra 4100 operators manual and re-validate analyser performance.

b. Verify continuity of wiring between the 1166 pressure transmitter PCB and the Multiplexer PCB. Correct or replace where necessary and verify instrument performance.

c. By varying the pressure to the pressure sensor check the operation of the pressure sensor and transmitter PCB. Correct or replace where necessary and verify instrument performance.

5.4 Pm O_2 Control Transducer Faults

5.4.1 Diagnostics measurements

Table 5.5 shows a list of the diagnostic signals available for the Pm O_2 Control transducer.

Table 5.5 Diagnostic signals for the Pm O_2 Control transducer

Diagnostic	Description	Typical level	Range
CELL EMF	Cell output volts	0.2 V	-0.1 to 1.2 V
CELL TEMP	Cell temperature	35 °C	5 to 70 °C

5.4.2 Fault messages

Table 5.6 shows a list of the indicated fault conditions for the Pm O_2 Control transducer.

Table 5.6 Fault messages for the Pm O_2 Control transducer		
Fault indicated	**Possible causes**	**Recommended action**
CELL VOLTS HIGH	Faulty component	See section 5.4.3
CELL VOLTS LOW	Faulty component	See section 5.4.3
CELL TEMP HIGH	Ambient temperature too high or faulty component	Check ambient temperature < 40°C. See also section 5.4.3
CELL TEMP LOW	Faulty component	See section 5.4.3
HIGH CAL/CHK OUTSIDE TOL or LOW CAL/CHK OUTSIDE TOL	User set low or high calibration tolerance has been exceeded during auto calibration	See section 5.4.4
HI CAL/CHK OUTSIDE RANGE or LO CAL/CHK OUTSIDE RANGE	The gas concentration in the autocalibration configuration is outside of acceptable limits.	Respecify the calibration gas concentration.
HI CAL RESULT OUTSIDE LIMITS or LO CAL RESULT OUTSIDE LIMITS	The autocalibration results differ from the existing values by more than the tolerance limits.	See section 5.4.4.

5.4.3 Transducer faults

Symptoms:

No response from transducer with changing gas composition.
Transducer producing invalid results.

Measurements and Diagnosis:

a. Verify continuity of interconnecting wiring between the measurement cell and the house keeping PCB and between the transducer and the Multiplexer PCB. Correct or replace where necessary and verify instrument performance.

b. Verify the power supply 5V rail voltage on the multiplexer PCB.

TP05 wrt TP01 +5.05V ± 0.25V

If the supply voltage is low or is not present then disconnect the following units in order to determine whether the 5V rail is being pulled down or the switched mode PSU is faulty:
Ensure that the instrument is switched off before connecting or disconnecting PCB assemblies.

Gas sensor modules.
Option boards.
Sensor interface boards.
Keypad ribbon cable.
Microprocessor board.
Multiplexer board (by elimination of other possible causes).

Correct or replace where necessary and verify instrument performance.

c. Check the following output voltages on connector PL1 on the transducer house keeping PCB.

Pin 12	Cell temperature.
Pin 10	Cell output EMF.

Verify that these signals reflect the input gas composition when nitrogen and air gas samples are applied to the inlet port. If the output voltages are incorrect then replace the transducer and re-verify the transducer performance.

d. Verify that the instrument diagnostic display for the transducer output EMF and temperature conform with those measured on pins 10 and 12 on connector PL1 on the transducer house keeping PCB. If these are incorrect then the fault may lie within either the Multiplexer PCB or the Signal Interface PCB. Correct or replace where necessary and verify instrument performance.

e. If none of the above tests have identified a problem then replace the transducer and verify instrument performance.

5.4.4 Measurement faults

Symptoms:

Unable to perform zero calibration.
Unable to perform span calibration.
Calibration failure fault indicated.
Low instrument sensitivity.
Poor instrument accuracy.

Measurements and Diagnosis:

a. Verify contents of the calibration gas samples have been correctly entered into the instrument software and that calibration gases are correctly connected. Check that calibration gas supply is not exhausted. Increase the calibration tolerance if necessary. Correct or replace where necessary and perform instrument calibration to verify performance.

b. Check that the concentration of the calibration sample corresponds with the concentration specified in the autocalibration configuration. Perform a ONE CYCLE autocalibration to clear the fault.

c. Verify correct operation of autocalibration valves if fitted. Perform a leak test to verify cross seat leakages. Correct fault in accordance with section 5.2.12 if necessary. Correct or replace where necessary and perform instrument calibration to verify performance.

d. Verify that there are no leaks in the internal pipe work and that flow meters operate correctly (if fitted). Correct or replace where necessary and perform instrument calibration to verify performance.

e. Verify that there are no blockages in the sample filter (if fitted) and internal flow restrictors. Correct or replace where necessary and perform instrument calibration to verify performance.

f. Verify that the instrument exhaust port is not restricted and that the instrument is not being pressurised above ambient pressure. Correct or replace where necessary and perform instrument calibration to verify performance.

g. Check the cell output voltage using pins 9 and 10 on connector PL1 on the transducer house keeping PCB (see drawing 01156/102). Check that the output varies from 0V to 0.21V as a zero and air sample are applied to the sample input port for the specific gas stream. Correct or replace transducer and PCB where necessary and re-verify performance.

h. Verify continuity of interconnecting wiring from the transducer cell to the transducer house keeping PCB and from the transducer to the MULTIPLEXER PCB. Correct or replace where necessary and re-verify instrument performance.

i. Check the cell output shown in the instrument diagnostics display matches the output voltage given on pins 9 and 10 on connector PL1 of the transducer housekeeping PCB (see also drawing 01156/102). Fault is likely to be either the Sensor Interface PCB or the Multiplexer PCB. Identify and replace the faulty PCB where necessary and re-verify performance.

5.4.5 Stability faults

Symptoms:

Noisy reading.
Reading drifts.
Instrument requires frequent re-calibration.

Measurements and Diagnosis:

a. Verify that the sample flow rate through the transducer is in the range 100-250 ml/min and is stable. Correct or replace where necessary and re-verify instrument performance.

b. Perform a leak test to verify that the internal pipe work is free from leaks. Correct or replace where necessary and re-verify instrument performance.

c. Verify that the sample filter (if fitted) is not blocked and that there are no obstructions within the instrument vent line. Correct or replace where necessary and re-verify instrument performance.

d. Verify that the instrument is free from condensed water. Correct or replace where necessary and re-verify instrument performance.

e. Verify continuity of interconnecting wiring from the transducer cell to the transducer house keeping PCB and from the transducer to the MULTIPLEXER PCB. Correct or replace where necessary and re-verify instrument performance.

f. Unplug the transducer from the MULTIPLEXER PCB and verify that the instrument is now stable. If not then the fault is likely to lie with the Sensor Interface PCB or MULTIPLEXER PCB. Identify and replace faulty PCB’s where necessary and re-verify instrument performance.

g. Check instrument sensitivity by performing a zero and span calibration. If the instrument sensitivity is low then perform the instrument measurement fault checks in section 5.4.4.

h. If none of these checks rectify the problem then replace the transducer and verify performance.

5.4.6 Flow faults

Symptoms:

Slow instrument response.
Drift.
Noise.
Flow sensitive results.

Measurement and Diagnosis:

a. Verify that the sample flow rate through the transducer is in the range 100-250 ml/min and is stable. Verify that any flow stability problems encountered are not produced by any sample conditioning system used prior to sample entry into the instrument. Particular attention should be made to knock out pots, sample pumps, chillers and filters. Correct or replace where necessary and re-verify instrument performance.

b. By performing a leak test verify that the internal pipe work within the instrument is leak tight. Pay particular attention to flow meter leakages if these are fitted. Correct or replace where necessary and re-verify instrument performance.

c. Verify that the optional sample filter (if fitted) is clean and not blocked. Correct or replace where necessary and re-verify instrument performance.

d. Verify that the orifice flow restrictors within the instrument are not blocked. Correct or replace where necessary and re-verify instrument performance.

e. Verify that the pipe work attached to the instrument vent is not restrictive and resulting in pressurisation of the sample cell. Correct or replace where necessary and re-verify instrument performance.

f. Verify that the transducer is not contaminated (particularly with condensed water). Correct or replace transducer if necessary and re-verify instrument performance.

g. Replace transducer and verify that the problem is corrected.

5.5 Zirconia transducer faults

This section of the manual covers likely fault symptoms associated with the zirconia transducer assemblies. The faults are categorised by the observed symptoms.

5.5.1 Diagnostic measurements

Table 5.7 shows a list of the diagnostic signals available for the zirconia transducer assembly.

Table 5.7 Diagnostic signals for the zirconia transducer			
Diagnostic	**Description**	**Typical level**	**Range**
CELL EMF	Cell output volts	0-400mV	-50 to 400mV
CELL TEMP	Cell temperature	575 or 720°C	525 to 625°C or 670 to 770°C

Zirconia cell temperature

This is the cell electrode temperature displayed in °C. A XXX fault is indicated if cell temperature exceeds 800°C or cell temperature less than 500°C after 3 minutes from switching on. The normal operating temperature for the Zr704 sensor is 575 °C. The normal operating temperature for the Zr703 sensor is 720 °C.

Zirconia cell EMF

This is the voltage output of the zirconia cell. The correct voltage can be determined from a knowledge of the sample gas concentration and the cell temperature using the Nernst equation shown below. Note that the output of the cell is nominally zero with air as the sample, the output increases with decreasing oxygen. Samples with more oxygen than air (20.95 % oxygen) will give a negative cell output.

$$E = E_0 + 0.021543 \cdot T \cdot \mathrm{Ln}\,(20.95 / \%\ \text{oxygen in sample})$$

E = Cell output (mV)
E_0= Cell offset (mV)
T = Cell temperature (°K)

E_0 may be determined by using air as the sample.
Note that the cell temperature is display in °C whereas the Nernst equation required °K . To convert to °K add 273 to the °C reading.

Sample calculation, assuming the sample gas is 0.3% oxygen and the cell is running at 575°C:

$$E = E_0 + (0.021543 \cdot (575+273) \cdot \mathrm{Ln}\,(20.95/0.3) = E_0+77.57\ \text{mV}$$

A XXX fault is indicated if the zirconia cell output lies outside of the range -50 to 500mV.

5.5.2 Fault messages

Table 5.8 shows a list of the indicated fault conditions for the zirconia transducer assemblies.

Table 5.8 Fault messages for the zirconia transducer

Fault message	Fault history message	Remedial action
CELL TEMP LOW	CELL T LO	Check cell thermocouple connections and polarity to PCB. Check fuses F1 to F8 on multiplexer PCB. Check links on PCB.
CELL TEMP HIGH	CELL T HI	Check thermocouple connections. Check links on PCB. Check/replace zirconia cell.
CELL EMF LOW	CELL E LO	Check cell electrical connections. Check links on PCB. Check/replace PCB. Check/replace zirconia cell.
CELL EMF HIGH	CELL E HI	

5.5.3 Transducer faults

Symptoms:

CELL TEMP LOW fault reported.
CELL TEMP HIGH fault reported.
CELL EMF LOW fault reported.
CELL EMF HIGH fault reported.
No response from transducer with changing gas composition.
Oxygen reading low.
Transducer producing invalid results.

Measurements and Diagnosis:

NOTE

A low (or zero) oxygen reading is a normal instrument response to the presence of combustibles components in the sample gas stream and may not be an instrument fault.

The reduction in the oxygen reading reported is dependant on the combustibles level present and cell type. If there is sufficient combustibles in the sample gas to consume all of the oxygen present, resulting in reducing conditions at the cell electrode, then a zero oxygen reading may occur.

a. Verify continuity of interconnecting wiring between the zirconia measurement cell and the house keeping PCB and the two connections (20 way and 7 way) between the transducer and the Multiplexer PCB. Correct or replace where necessary and verify instrument performance.

b. Verify the 15VAC rail voltage supplies to the transducer house keeping PCB. These supplies are provided on the 7 way connector PL1.

Pin 5	15V AC
Pin 6	0V AC
Pin 7	15V AC

If the voltages are incorrect then check the appropriate fuses (F1 to F8) on the multiplexer PCB. Correct or replace where necessary and verify instrument performance.

c. Verify that the instrument diagnostic display for the transducer output and temperature conform with the signals measured on connector PL2 on the transducer house keeping PCB.

Pin 12	Cell temperature.
Pin 10	Cell output EMF.

The cell temperature output on pin 12 of PL2 is scaled to give 1±0.05 mV per °C. If the displayed signals are incorrect then the fault may lie within either the Multiplexer PCB or the Signal Interface PCB. Correct or replace where necessary and verify instrument performance.

d. Check link settings on the house keeping PCB.

e. Check that the sensor temperature is correct for the cell type and that the temperature control is operating. The normal operating temperature for the Zr704 cell is 575 °C and for the Zr703 cell is 720 °C. If faulty then check the cell thermocouple connections on pins 4 and 5 of terminal block TB1. Correct or replace the zirconia cell and/or house keeping PCB and verify instrument performance.

f. Check that the cell output EMF signal on pin 10 of connector PL2 reflects

the input gas composition when nitrogen and air gas samples are applied to the inlet port.

g. If none of the above tests have identified a problem then replace the transducer and verify instrument performance.

5.5.4 Measurement faults

Symptoms:

Unable to perform zero calibration.
Unable to perform span calibration.
Calibration failure fault indicated.
Low instrument sensitivity.
Poor instrument accuracy.

Measurements and Diagnosis:

a. Verify contents of the calibration gas samples have been correctly entered into the instrument software and that calibration gases are correctly connected. Correct or replace where necessary and verify performance.

b. Verify that there are no leaks in the internal pipe work and that flow meters operate correctly (if fitted). Correct or replace where necessary and perform instrument calibration to verify performance.

c. Verify that there are no leaks in the pipework to other transducers within the xentra chassis (or even other analysers) that is causing the oxygen level used as a reference to the zirconia cell to be enriched or depleted.

d. Verify that there are no blockages in the in the restrictive ‘T’ assemblies (for pressure driven options). Refer to section 6.21. Correct or replace where necessary and perform instrument calibration to verify performance.

e. Verify that the instrument exhaust port is not restricted and that the instrument is not being pressurised above ambient pressure. Correct or replace where necessary and perform instrument calibration to verify performance.

f. Perform the transducer performance checks listed in section 5.5.3.

5.5.5 Stability faults

Symptoms:

Noisy reading.
Reading drifts.

Instrument requires frequent re-calibration.

Measurements and Diagnosis:

a. Verify that the sample inlet pressure or flow is within the required range. For pressure driven options this is 5psig ±3psig (35kPag ±21kPag). For flow driven options this is 200 to 550 ml/min. Correct or replace where necessary and re-verify instrument performance.

b. Perform a leak test to verify that the internal pipe work is free from leaks. Correct or replace where necessary and re-verify instrument performance.

c. Verify that there are no obstructions within the instrument vent line. Correct or replace where necessary and re-verify instrument performance.

d. Check instrument sensitivity by performing a zero and span calibration. If the instrument sensitivity is low then perform the instrument measurement fault checks in section 5.5.3.

e. If none of these checks rectify the problem then replace the transducer and verify performance.

5.5.6 Flow faults

Symptoms:

Slow instrument response.
Drift.
Noise.
Flow sensitive results.

Measurement and Diagnosis:

a. Verify that the sample inlet pressure or flow is within the required range. For pressure driven options this is 5psig ±3psig (35kPag ±21kPag). For flow driven options this is 200 to 550 ml/min. Correct or replace where necessary and re-verify instrument performance.

b. By performing a leak test verify that the internal pipe work within the instrument is leak tight. Pay particular attention to flow meter leakages if these are fitted. Correct or replace where necessary and re-verify instrument performance.

c. Verify that the orifice flow restrictors within the instrument are not blocked. Correct or replace where necessary and re-verify instrument performance.

d. Verify that the pipe work attached to the instrument vent is not restrictive

and resulting in pressurisation of the sample cell. Correct or replace where necessary and re-verify instrument performance.

e. Replace transducer and verify that the problem is corrected.

5.6 1210 Gfx Transducer Faults

5.6.1 Diagnostics measurements

Table 5.8 shows a list of the diagnostic signals available for the Gfx1210 transducer.

Table 5.8 Diagnostic signals for the Gfx 1210 transducer

Diagnostic	Description	Typical level	Range
DIF SIG	Difference signal between the Gas and N_2 filled filters	0.000V	-0.25 to 1.31 V
GAS SIG	Signal level for the Gas filled filter	1.000 V	0.5 to 1.31 V
N2 SIG	Signal level for the N_2 filled filter	1.000 V	0.5 to 1.31 V
SAMPLE TEMP	Sample temperature	30°C	0 to 50°C
CHOPPER TEMP	Chopper box temperature	70 °C	60 to 80 °C

5.6.2 Fault messages

Table 5.9 shows a list of the indicated fault conditions for the Gfx 1210 transducer.

Table 5.9 Fault messages for the Gfx1210 transducer		
Fault indicated	**Possible causes**	**Recommended action**
TRANSDUCER NOT RESPONDING	Faulty component	See section 5.6.3
CHOP TEMP LOW or CHOP TEMP HIGH	Faulty component.	See section 5.6.3.
LO V/C OUTSIDE TOL or HI V/C OUTSIDE TOL	User set low or high calibration tolerance has been exceeded during autocalibration.	See section 5.6.4
LO V/C OUTSIDE RANGE or HI V/C OUTSIDE RANGE	The gas concentration in the autocalibration configuration are outside of limits.	Respecify the calibration gas concentration.
LO CAL OUTSIDE LIMITS or HI CAL OUTSIDE LIMITS	The results of an autocalibration differ from the existing values by more than the tolerance limits.	See section 5.6.4

5.6.3 Transducer faults

The Gfx 1210 transducer performs some basic checks of the functionality of the main circuits and in the case that a malfunction is identified, a logic signal (Gfx transducer faulty) is sent to the Xentra unit in order to inform the user that the transducer is faulty. A faulty Gfx signal will activate the Fault Icon on the Xentra screen and the corresponding measurement value field will read ‘VOID’. Other faults identified within the Xentra chassis will activate the Fault Icon only. The green LED (D16) on the housekeeping PCB (01210903) indicates the status of the transducer. This LED will be extinguished if a transducer fault is sensed.

Figure 5.2 shows possible fault causes that would result in the D16 green LED being extinguished.

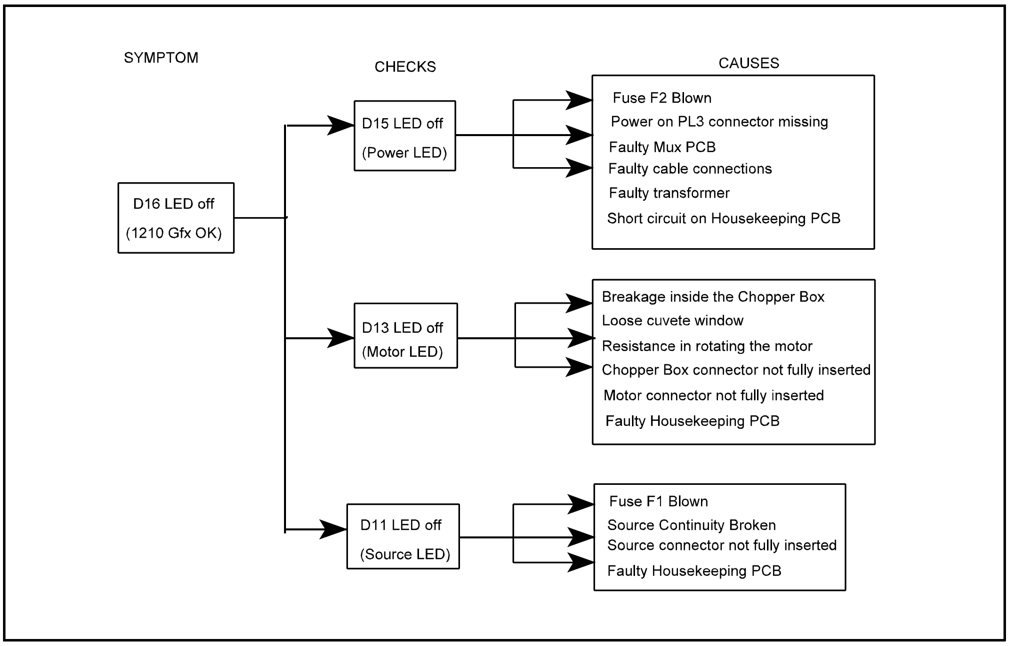

Figure 5.2 Gfx fault icon on diagnosis tree

The following checks and investigations should be carried out:

The D16 LED (bench OK LED) is off.

Measurements and diagnosis:

Check that at least one other LED on the Housekeeping PCB is off.

If all other LEDs are on, change the Housekeeping PCB. If another LED is off, go to the respective point in the Investigation procedure.

The D15 LED (power OK LED) is off

Measurements and diagnosis:

a. Check the fuse F2. Replace the fuse if it is blown and retest. If the fuse blows again then replace the Housekeeping PCB. If the fuse is OK and the D15 LED is still off then replace the Housekeeping PCB.

b. Check the power supply on pins 5 and 7 of connector PL3. An ac voltage of approximately 36 volts should be present. If the supply voltage is faulty then disconnect the PL3 connector and check the voltage again. If the voltage is now OK then replace the Housekeeping PCB. Otherwise check the voltage on the transformer and replace if faulty. If the transformer is OK then check the Multiplexer PCB, the transformer and the cable connectors.

The D13 LED (motor in synchronisation) is off.

Measurements and diagnosis:

a. Check that the motor is rotating freely. If the motor is not rotating freely, check for foreign bodies or any other damage. Identify the cause of damage or foreign bodies, and replace the relevant parts before rechecking that the motor is rotating freely. Note that at very low temperatures, correct chopper speed may take some time to achieve.

b. If the motor is not jammed and the D13 LED is still off, check the continuity of the cable connections. Check that the motor connector from the chopper box is fully inserted.

c. If continuity is satisfactory, replace the motor. If the LED is still off replace the Housekeeping PCB.

The D11 LED (source OK LED) is off.

Measurements and diagnosis:

a. Check the fuse F1. Replace the fuse if it is blown and retest. If the fuse blows again then replace the Housekeeping PCB.

b. If the fuse is OK then check that the source resistance is approximately one ohm. Replace the source if the resistance is incorrect.

c. Check that the voltage across the source is between 1.9 and 2.1 Vdc. If not then replace the house keeping PCB.

5.6.4 Measurement faults

Symptoms:

Unable to perform zero calibration.
Unable to perform span calibration.
Calibration failure fault indicated.
Low instrument sensitivity.
Poor instrument accuracy.

Measurements and Diagnosis:

a. Verify contents of the calibration gas samples have been correctly entered into the instrument software and that calibration gases are not empty and are correctly connected. Increase calibration tolerance if necessary. Correct or replace where necessary and perform instrument calibration to verify performance.

b. Check that concentration of calibration sample corresponds with concentration specified in auto calibration configuration. Perform an automatic ONE CYCLE calibration to clear fault.

c. Verify correct operation of autocalibration valves if fitted. Perform a leak test to verify cross seat leakages. Correct fault in accordance with section 5.2.12 if necessary. Correct or replace where necessary and perform instrument calibration to verify performance.

d. Verify that there are no leaks in the internal pipe work and that flow meters operate correctly (if fitted). Correct or replace where necessary and perform instrument calibration to verify performance.

e. Verify that there are no blockages in the in the restrictive ‘T’ assemblies (for pressure driven options). Correct or replace where necessary and perform instrument calibration to verify performance. Refer to section 6.21 for typical restrictor assembly.

f. Verify that the instrument exhaust port is not restricted and that the instrument is not being pressurised significantly above ambient pressure. Correct or replace where necessary and perform instrument calibration to verify performance.

g. Verify continuity of interconnecting wiring within the transducer and from the transducer to the Multiplexer PCB. Correct or replace where necessary and re-verify instrument performance.

h. Check that the cell outputs shown in the instrument diagnostics display match the output voltage given from the transducer. Fault is likely to be either the Sensor Interface PCB or the Multiplexer PCB. Identify and replace faulty PCB where necessary and re-verify performance.

5.6.5 Stability faults

Symptoms:

Excessive measurement noise.
Excessive instrument drift.
Low instrument sensitivity.
Poor instrument accuracy.

Measurement and Diagnosis:

a. Measure the optical throughput of the transducer to establish any contamination of windows, cells and/or mirrors. To do this look at the value of VN2 in the diagnostics menu. During factory calibration this voltage is set to 1.00v, any loss of energy throughput will reduce this reading. If the value is less than 0.75v then check the following:

   - The source voltage setting is 2.0v (position 5 on SW1 on 1210/903).
   - The detector is at the correct position using the correct spacers (See section 6.37).
   - The optical components are not contaminated or damaged (see sections 6.34, 6.35, 6.36).

b. An exhausted scrubber will cause drift, usually correlated to changes in ambient temperature. If this is observed, check for leaks in the chopper box and detector enclosures and replace the appropriate scrubber. (See sections 6.32, 6.37.)

c. Excessive, continual positive zero drift associated with a decrease in instrument sensitivity is an indication of gas filter leakage. If a gas filter fails, it usually does so rapidly giving an instrument with a large positive offset which does not respond to span gas. If this is the case replace the chopper wheel.

   If you suspect a slow leak from the gas filter, perform a ZERO CAL then expose the instrument to a certified span gas. If the instrument reads less than 50% of the span gas then replace the chopper wheel (see section 6.33) and return to Servomex for investigation.

d. Excess noise can be caused by a defective chopper motor. If the motor has difficulty starting or is audibly noisy then replace it (see section 6.32) and return the motor to Servomex for investigation.

e. In very rare instances the detector may be faulty. Connect a scope to TP1 (wrt TP5) on the signal processing PCB (1210/902). The trace should be stable and look like the trace shown in figure 6.21. If the signal is very noisy then replace the detector PCB (see section 6.37).

5.6.6 Flow faults

Symptoms:

Slow instrument response.
Inaccurate instrument results.
Flow sensitive results.

Measurement and Diagnosis:

a. Verify that the sample flow rate through the transducer is in the range 500-2500 ml/min. Verify that any flow problems encountered are not produced by any sample conditioning system used prior to sample entry into the instrument. Particular attention should be made to knock out pots, sample pumps, chillers and filters. Correct or replace where necessary and re-verify instrument performance.

b. By performing a leak test verify that the internal pipe work within the instrument is leak tight. Pay particular attention to flow meter leakages if these are fitted. Correct or replace where necessary and re-verify instrument performance.

c. Verify that the restrictive 'T' assembly (for pressure driven option) within the instrument are not blocked. Correct or replace where necessary and re-verify instrument performance.

d. Verify that the sample pipe work attached to the instrument vent is not restrictive and resulting in excessive pressurisation of the sample cell. Correct or replace where necessary and re-verify instrument performance.

f. Verify that the transducer is not contaminated (particularly with condensed water). Clean the optical cell and / or replace the optical windows and mirrors if necessary and re-verify instrument performance.

NOTES

SECTION 6: PARTS REPLACEMENT PROCEDURES

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6 PARTS REPLACEMENT PROCEDURES

6.1 Cover

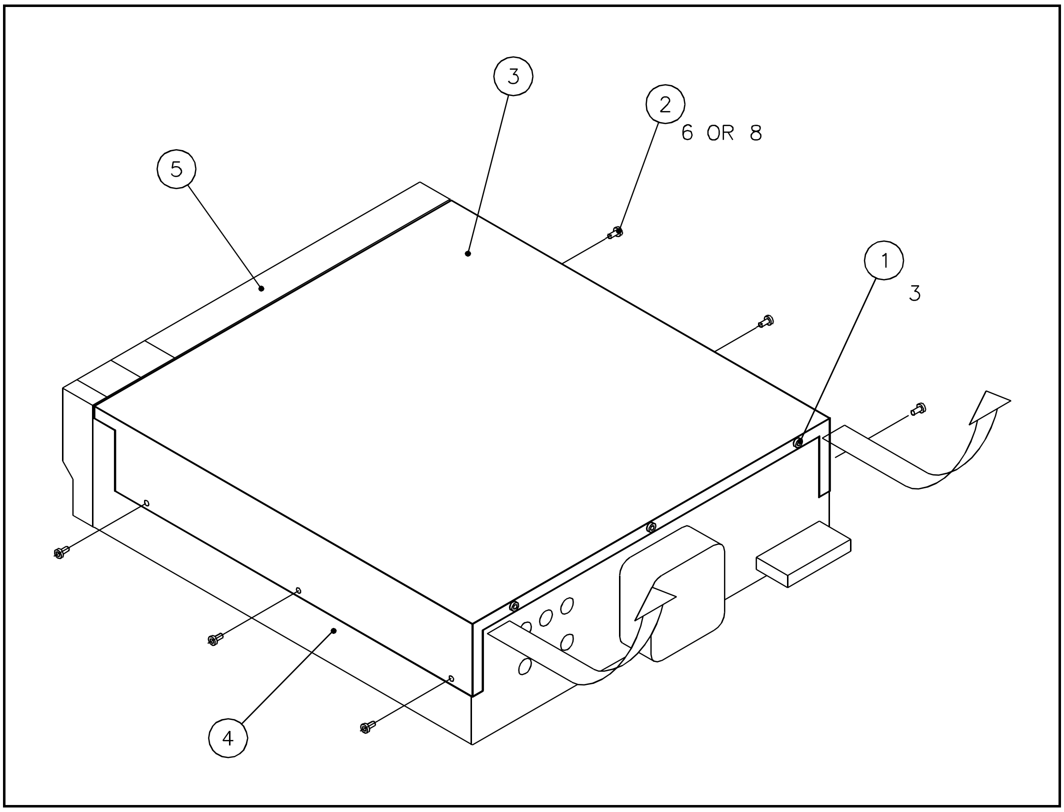

Figure 6.1 Cover removal

Refer to figure 6.1

Removal

a) Remove 6 off screws [2], 3 on each side of chassis, (8 of screws for long chassis).

b) Loosen 3 of screws on rear of chassis [1].

c) Lift rear of cover to clear rear screws and slide cover backwards to remove.

Refitting

a) Ensure that conductive EMC gasket (figure 6.3 [1]) is intact at front of chassis.

b) Ensure that tongues at front of cover are fully engaged in chassis. Lower rear of cover ensuring that cover is located under rear fixing screws [1].

c) Refit screws [2] to side of cover.

d) Retighten all screws

NOTE

Following satisfactory performance checks, the appropriate tamper-proof label should be attached.

6.2 Fascia Removal

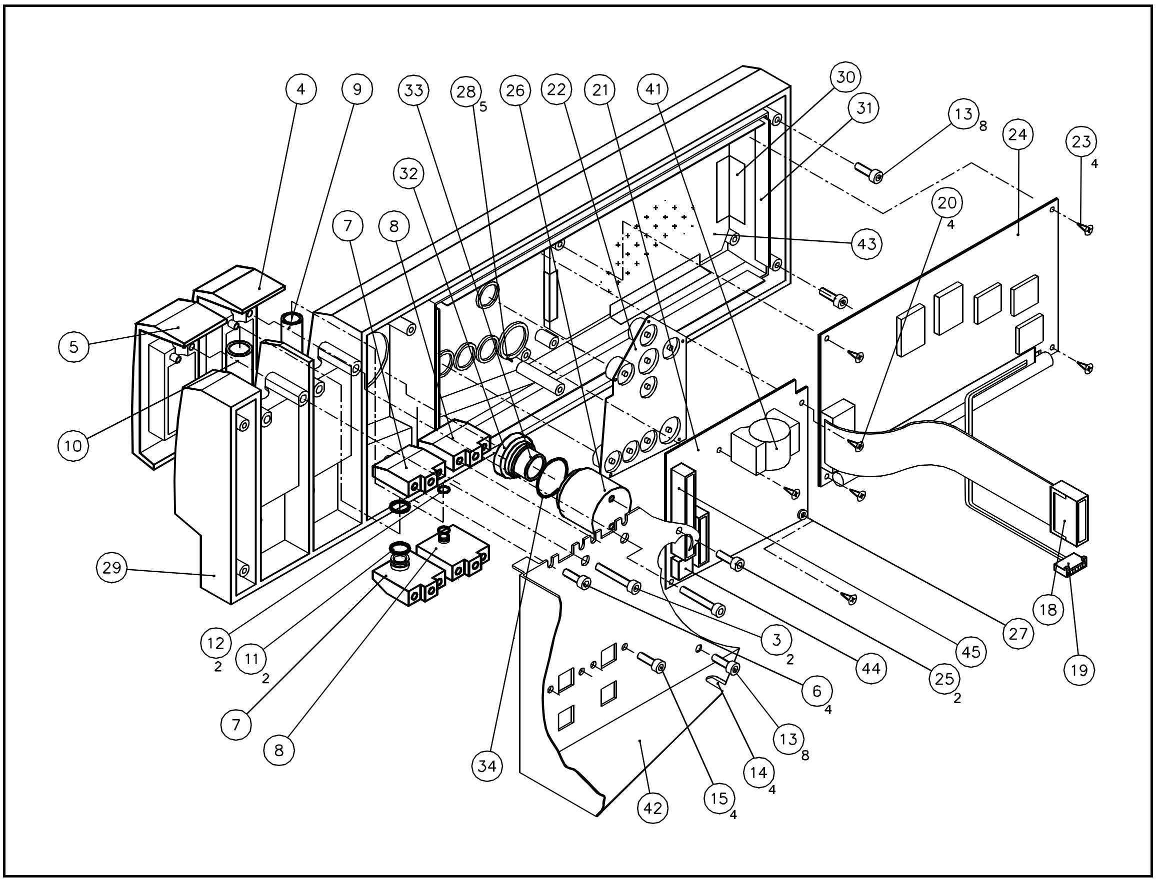

Figure 6.2 Exploded view of fascia

Refer to figure 6.2

Removal

a) Remove cover (See section 6.1)..

b) If flow tubes are fitted [9,10] remove flow tubes (see section 6.6).

c) Remove 8 off screws (figure 6.3[8]) which fix the fascia to the chassis. Access to the bottom four screws may be gained via the slots in the underside of the chassis [14] using a 'ball-end' hexagon key.

d) Lift fascia directly away from chassis to clear flow tube bottom end-blocks [7,8]. Disconnect keypad ribbon cable (figure 6.3[2]) from the Keypad PCB connector [45]. The fascia may now be lifted away from the chassis. Whilst working on the fascia lay it on a soft surface to prevent damage.

Refitting

Use reverse procedure.

NOTE
Ensure that conductive EMC gaskets [31] are intact and securely fitted.

6.3 Keypad PCB and rubber mat

Refer to figure 6.2

Removal

a) Remove fascia (see section 6.2)
b) Remove display connectors [18,19]
c) Remove four keypad fixing screws [20]
d) The keypad may now be lifted away from the fascia

Refitting

a) Ensure that keypad rubber mat is located over five lugs in fascia moulding [28].
b) Fit Keypad PCB over five lugs in fascia moulding [28].
c) Ensure that Keypad PCB fixing screw spacer is present in bottom right fixing position [27]
d) Use reverse procedure from here.

NOTE
Avoid touching the gold platted contact areas on the keypad PCB or the contact pills in the rubber mat.

6.4 Display

Refer to figure 6.2

NOTE
Avoid touching the liquid crystal at the front of the display and the inner surface of the window.

Removal

a) Remove fascia (see section 6.2)
b) Remove display connectors [18,19]
c) Remove four display fixing screws [23]
d) The display [24] may now be lifted away from the fascia.

Refitting
Use reverse procedure.

6.5 Keypad ribbon cable

Refer to figure 6.3

Removal

a) Remove fascia (see section 6.2).
b) Disconnect Keypad ribbon cable [2] from Motherboard [4]
c) Prise off two ribbon cable clamps [9] and remove ribbon cable.

Refitting

a) Peel off adhesive backing from ribbon cable clamps and position in place of original clamps.
b) Connect Keypad ribbon cable to Motherboard and feed other end through grommet [7].
c) Dress ribbon cable[2] along side of chassis and fix to two ribbon cable clamps [9]

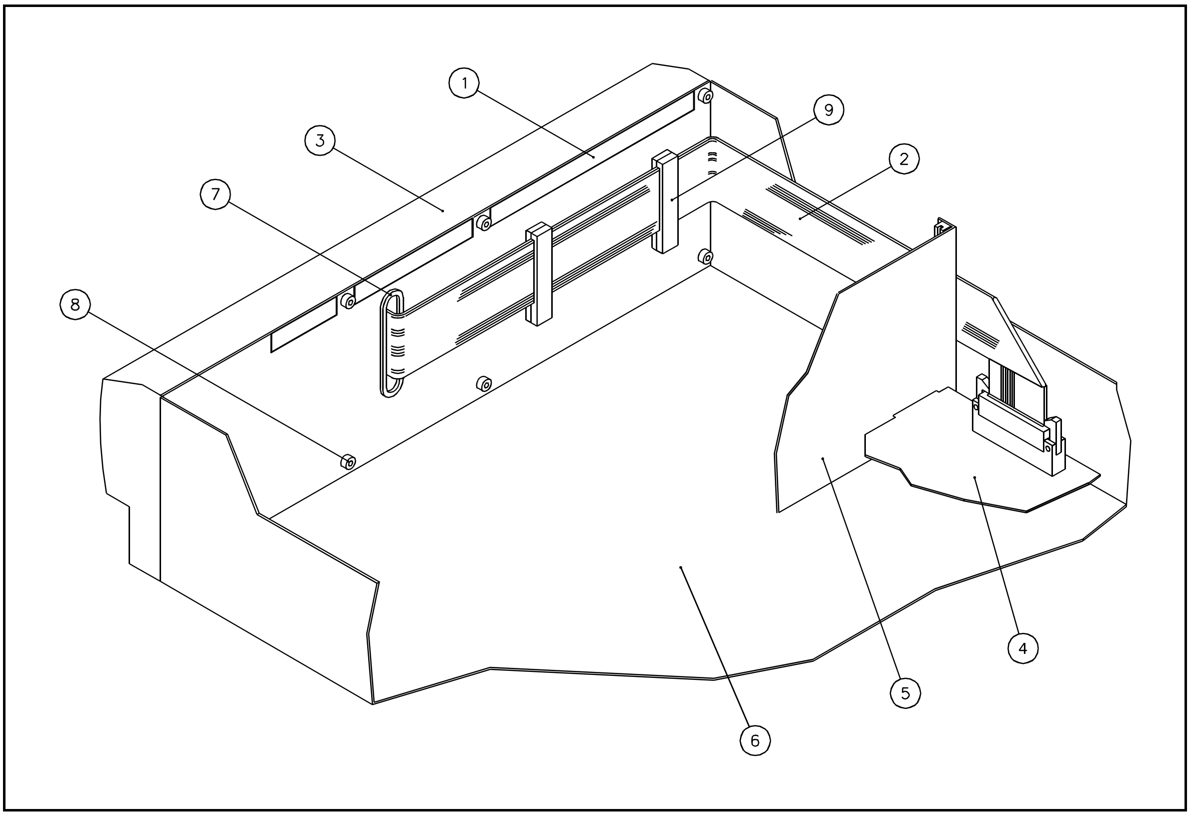

Figure 6.3 Keypad ribbon cable

6.6 Flow tubes

Refer to figure 6.2

> **NOTE**
>
> **Take care to keep the end-block spigot and flow tube concentric when removing and refitting, failure to do this will result in fracture of the flow tube.**

> **NOTE**
>
> **The sample and calibration gases used with the instrument may be toxic or asphyxiant. Ensure that gases are turned off and the instrument is flushed with inert gas before opening the instrument sample system to air.**

Removal

a) Remove cover (See section 6.1).
b) Remove flow tube cover fixing screws [3], one per flow tube cover. The flow tube covers [4,5] may then be removed by bringing top edge forwards and lifting.
c) Loosen top flow tube end-block [7,8] fixing screws [6], two per end-block. The end-blocks may now be lifted directly upwards, clear of the flow tubes [9,10] with the sample tubing still attached.
d) The flow tubes may now be lifted directly upwards, a slight twisting motion may be used to help release the tubes as they are lifted.
e) The end-block spigot ’o’ rings on the end-block spigots should only require removal if they need to be replaced. In this case the ’o’ rings may be prised off using a screwdriver and discarded.

Refitting

Use reverse procedure. Flow tube ’o’ rings may be lubricated with clean water, sparingly applied with a brush. Ensure that flow tube covers are replaced in correct positions, ie Sample and Bypass labels appear in correct positions.

6.7 Flow tube end-blocks

Refer to figure 6.2

NOTE

Take care to keep the end-block spigot and flow tube concentric when removing and refitting, failure to do this will result in fracture of the flow tube.

WARNING

The sample and calibration gases used with the instrument may be toxic or asphyxiant. Ensure that gases are turned off and the instrument is flushed with inert gas before opening the instrument sample system to air.

Removal

a) Remove gas sensor module from immediately behind flow tubes if fitted.
b) Remove fascia (see section 6.2)
d) Disconnect sample tubing from plastic adaptor.
e) Remove bottom flow tube end-block [7,8] and fixing screws [15]
f) The end-blocks may now be withdrawn from the fascia.
g) Remove end-block [7,8]

Refitting

Use reverse procedure.

6.8 Sample filter housing

Refer to figure 6.2

NOTE

Take care to keep the end-block spigot and flow tube concentric when removing and refitting, failure to do this will result in fracture of the flow tube.

NOTE

The sample and calibration gases used with the instrument may be toxic or asphyxiant. Ensure that gases are turned off and the instrument is flushed with inert gas before opening the instrument sample system to air.

Removal

a) Remove fascia (see section 6.2)
b) Slide spring clip on plastic adaptors fitted to filter housing back up sample tube by opening spring with pliers.
c) Disconnect sample tubing from plastic adaptor.
d) Remove plastic adaptors from filter housing (this may be supplied with the new housing)
e) Remove fixing screws [25]

Refitting

Use reverse procedure.

6.9 Switched mode power supply (Refer to figure 6.4)

Removal

a) Remove cover (see section 6.1)
b) Loosen fixing screw [18]
c) Pull power supply [19] directly upwards out of card guides.

Refitting

a) If replacing power supply fit fixing screw [18] from original power supply to new power supply.
b) Refit cover.

6.10 Transformer

Refer to figure 6.4

Removal

a) Remove cover (see section 6.1).
b) Remove power connector [9] without disconnecting from Motherboard.
c) Remove power supply [19] (see section 6.9).
d) Disconnect transformer [17] primary connector [12] and secondary connector [13].
e) Disconnect transformer earth lead from earth stud [22].

f) Remove two transformer fixing screws [15] and two washers [16] from underside of chassis.

Refitting

Use reverse procedure.

NOTE

Ensure that all protective earth connections are secure prior to refitting the cover.

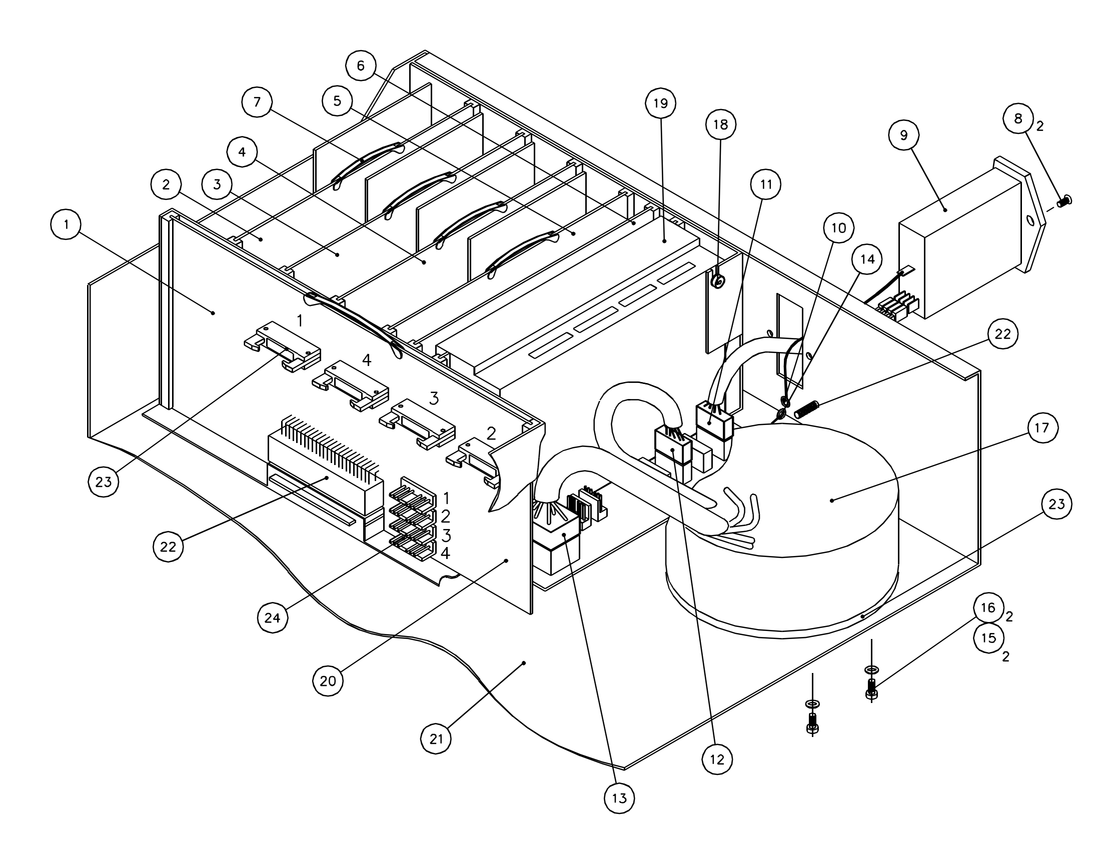

Figure 6.4 Card frame, transformer and IEC appliance adaptor

6.11 Power connector (Refer to figure 6.4)

Removal

a) Remove two power connector fixing screws [8] and partially withdraw power connector from rear of chassis to allow access to Motherboard connection [11].
b) Remove earth lead from earth stud [22]
c) Remove connector [11]
d) The power connector may now be removed from the chassis

Refitting

Refer to figure 6.4

Use reverse procedure.

NOTE

If fitting a new power connector use the fuse from the original power connector and ensure that voltage selector is correctly set. Ensure that all protective earth connections are secure prior to refitting the cover.

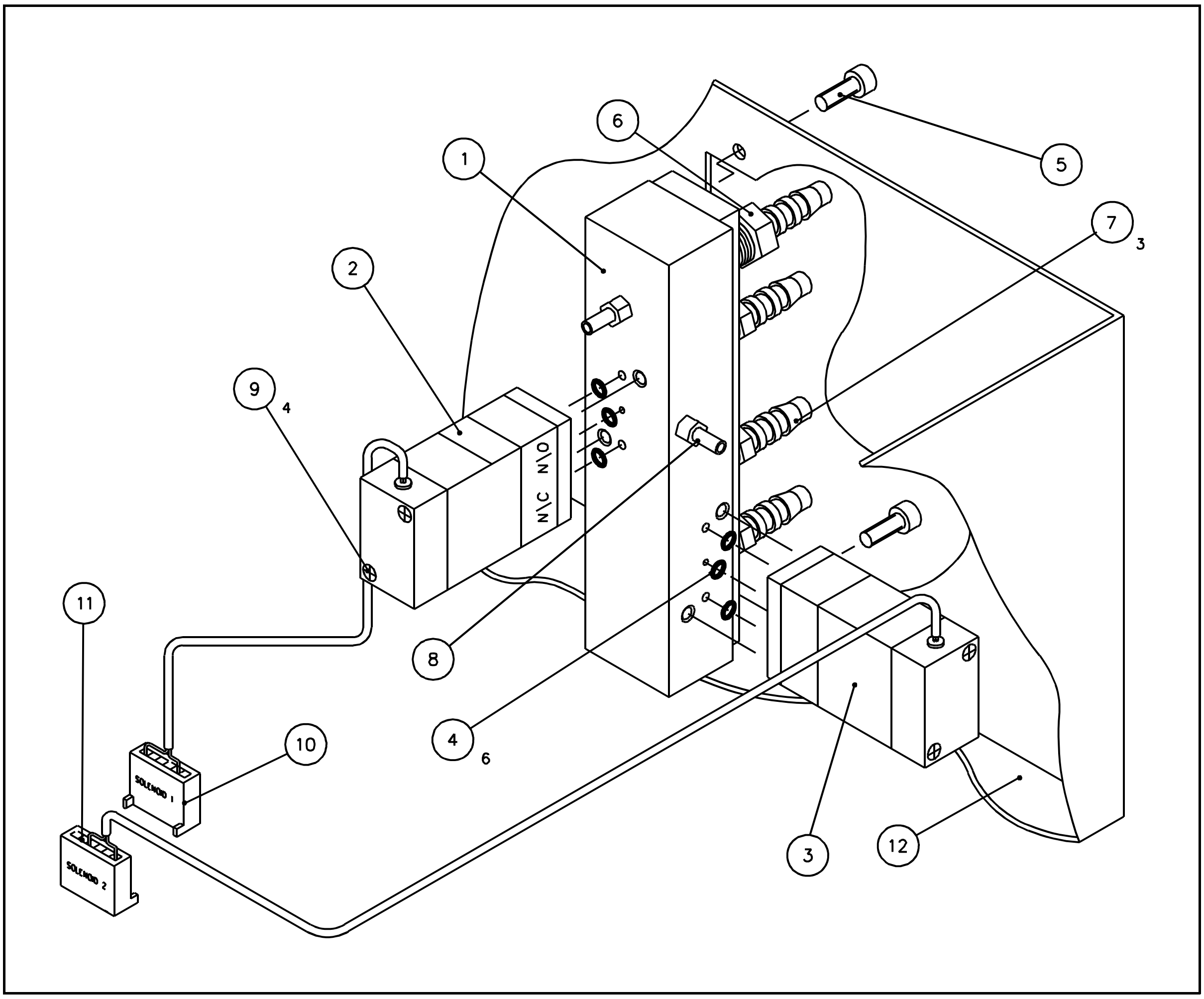

Figure 6.5a Solenoid valves and manifold

6.12 Autocalibration connections.

WARNING

The sample and calibration gases used with the instrument may be toxic or asphyxiant. Ensure that gases are turned off and the instrument is flushed with inert gas before opening the instrument sample system to air.

6.12.1 Manifold block and solenoid valves.

Refer to figure 6.5a.

Removal

a) Disconnect the sample inlet and outlet connections to the instrument.
b) Remove the cover (see section 6.1).
c) Disconnect the solenoid valve electrical connectors [10,11] from the motherboard.
d) Slide the hose clip on the two plastic pipe adaptors [8] fitted to the manifold block back up the sample tube by opening the spring clip with pliers.
e) Disconnect the sample tubing from the plastic adaptors.
f) Remove the two fixing screws [5] for the manifold block [1].
g) Lift the manifold block away from the gland plate.
h) Remove the solenoid valve fixing screws [9], two per solenoid valve. Remove the solenoid valve from the manifold block. Note that the 'o' rings [4] may become dislodged from the solenoid valve while removing.

Refitting

Use reverse procedure.

> **NOTE**
>
> **Ensure that the 'o' rings are in position when refitting solenoid valves to manifold block.**

6.12.2 External Autocal Relay PCB.

Refer to figure 6.5b.

Removal

a) Disconnect the external sample inlet and outlet connections to the instrument.
b) Remove the cover (see section 6.1).
c) Disconnect the electrical connectors [11,12] from the motherboard. (These leads are reversible and interchangeable.)
d) Slide the hose clips on the inside of the inlet and outlet connectors [1,2] back up the sample tube by opening the spring clip with pliers.
e) Disconnect the sample tubing from the inlet and outlet connectors

[1,2].

f) Remove the four fixing screws [3] which hold the gland plates [4,5] to the casing [13].

g) To lift the gland plate and PCB assembly clear of the casing, raise it vertically until the lower part of the PCB [8] is able to clear the case when the assembly is rotated, then lower it to clear the upper edge of the PCB.

h) Remove the nut and washer securing the earth strap from the PCB [8] to the functional grounding post [10].

i) Remove the nuts [9] to release the PCB [8] from supporting studs in the gland plate [5]. The spacers [6] are loose.

j) If necessary, the gland plates [4,5] can be separated by removing the retaining nuts [7] from the inlet and outlet connectors [1,2].

Refitting

Use reverse procedure.

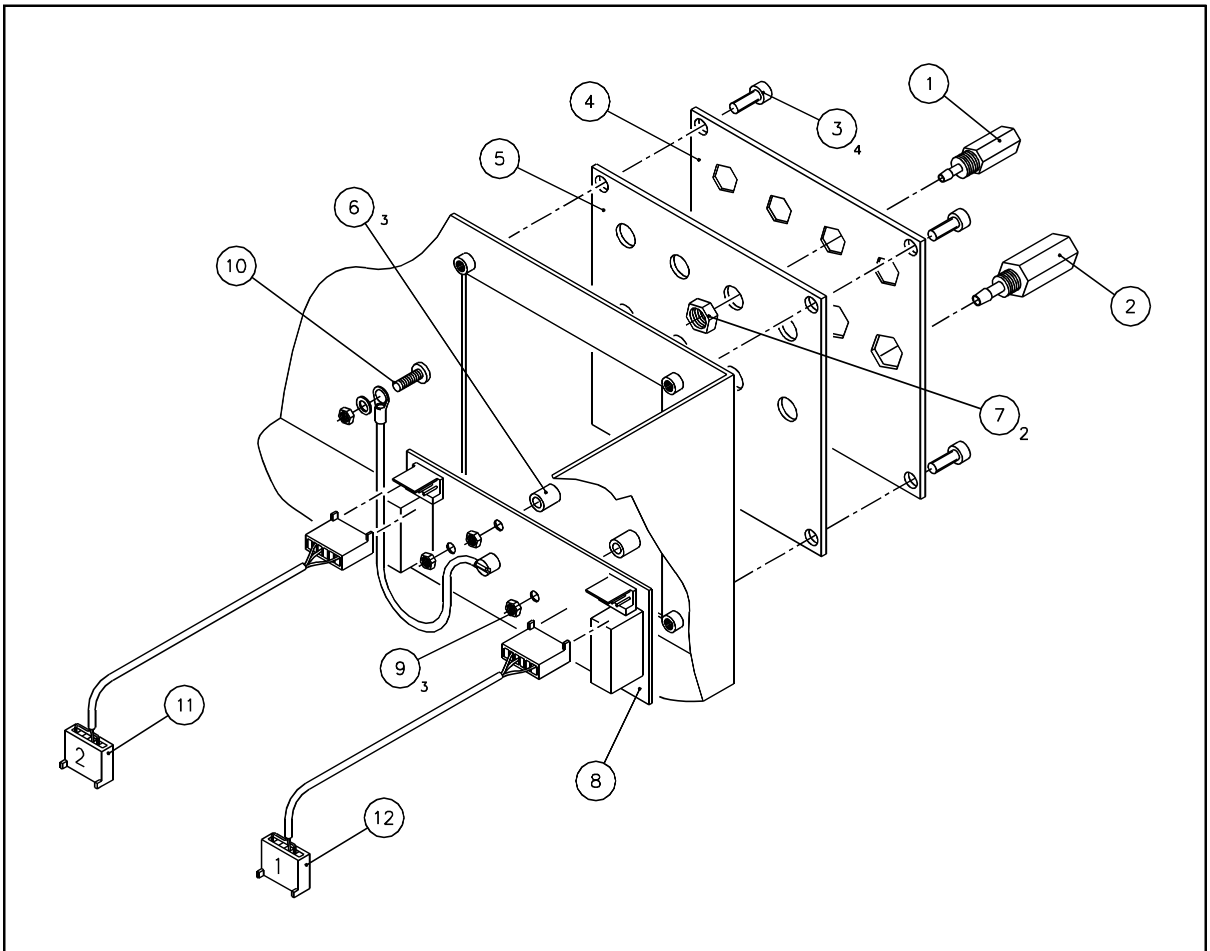

Figure 6.5b External autocalibration relay PCB

6.13 External fan

Refer to figure 6.6

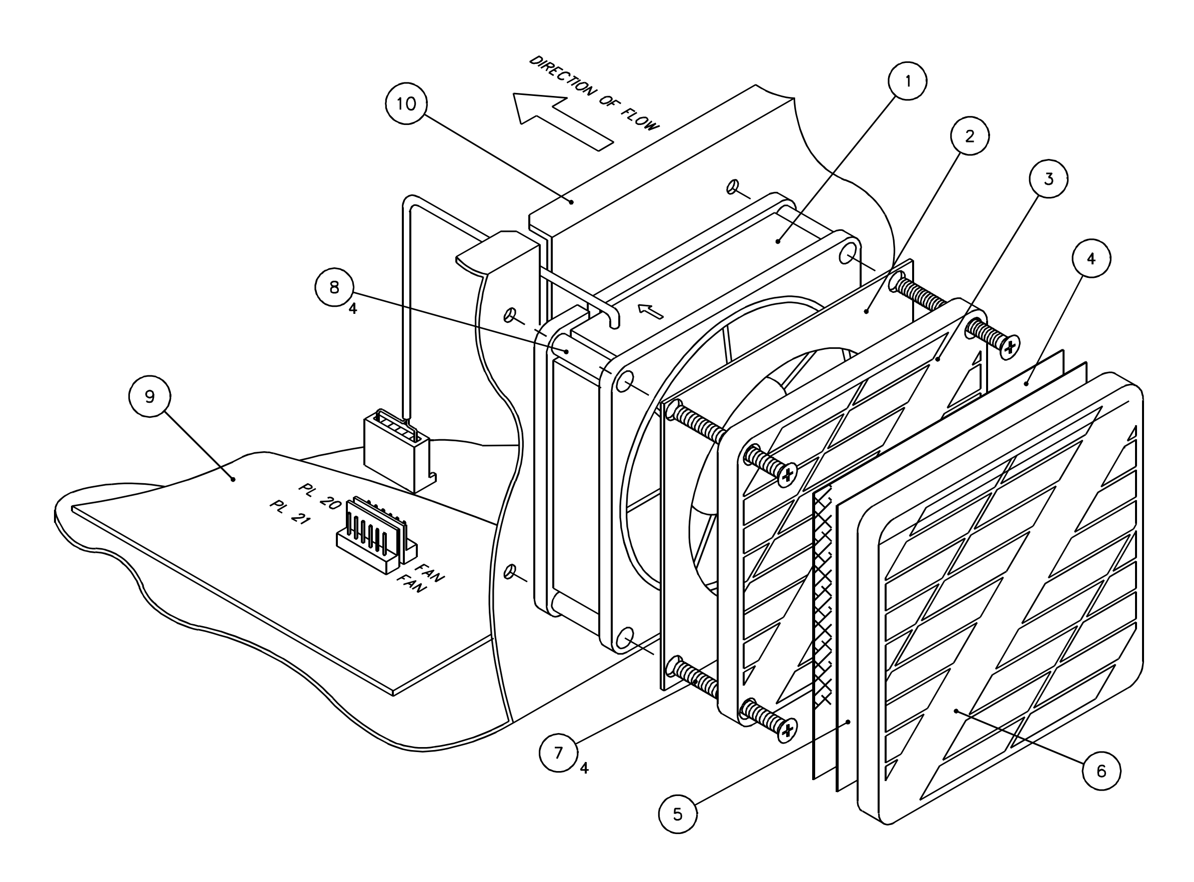

Figure 6.6 External fan

Removal

a) Remove cover (see section 6.1).
b) Remove power connector (see section 6.11).
c) Disconnect fan from Mother board [9].
d) Remove filter cover [6], filter gauze [5] and filter element [4].
e) Remove four off screws [7].
f) Remove finger guard [3] and spacer plate [2].
g) The fan may now be lifted away from the chassis.

Refitting

Use reverse procedure.

> **NOTE**
>
> **Ensure that flow direction arrow on the fan body is pointing towards the rear of the chassis.**

6.14 Internal fan

Refer to figure 6.7

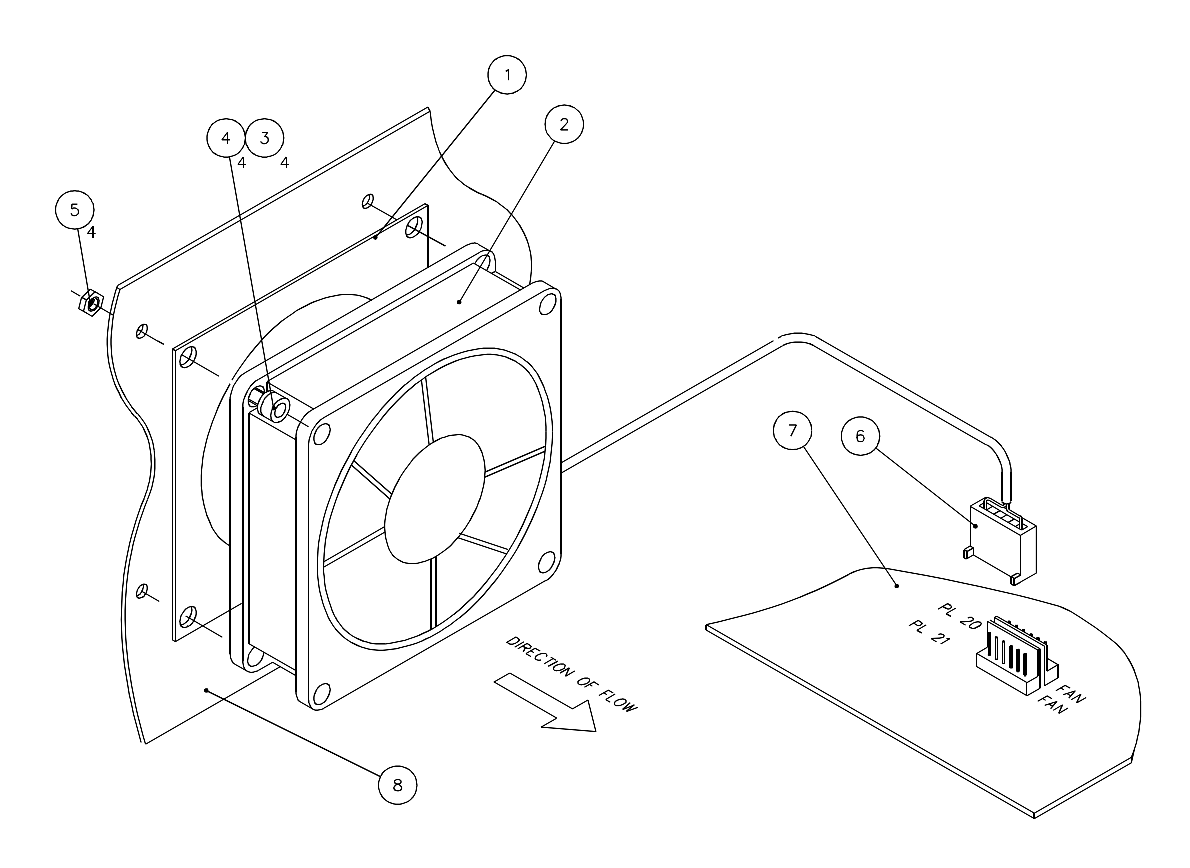

Figure 6.7 Internal fan

Removal

a) Remove cover (see section 6.1).
b) Disconnect fan connector [6] from Motherboard [7].
c) Remove four off fixing screws [4]
d) Remove fan spacer plate [1]
e) Unclip lead from Motherboard and remove fan from chassis.

Refitting

Use reverse procedure.

NOTE

Ensure that arrow on fan is pointing towards rear of chassis.

6.15 Microprocessor, Sensor Interface, and Option boards

CAUTION
The microprocessor board is a static sensitive device. Failure to implement good standard anti-static practices could result in damage. Take care to replace option boards and Sensor interface boards in their correct location. Any changes of card type recognised by the software will result in erasure of the current set-up of analogue outputs.

NOTE
If the microprocessor PCB is replaced, then the software of the analyser will need to be re-configured as described in section 7.2.
If a Gfx module is present in the 4100 then its' definitive calibration data will need to be transferred from the Gfx to the new microprocessor PCB using the 'DOWNLOAD' feature as described in section 7.3.2.

Removal

a) Remove cover (see section 6.1)
b) Touch bare metal on chassis to discharge any static electricity.
c) Slide board up out of card guide.
d) Store board in anti-static bag.

Refitting

a) Touch bare metal on chassis to discharge any static electricity.
b) Slide board into card guides and push firmly into Motherboard.
c) Refit cover.

6.16 Multiplexer board

Removal

Refer to figure 6.4

a) Remove cover (see section 6.1)
b) Touch bare metal on chassis to discharge any static electricity.
c) Slide Multiplexer board [1] up out of card guides with gas sensor module signal cables [23], power cables [24]. Lay Multiplexer on top of front card frame (figure 6.9[10]).
d) Remove signal cables [23] and power cables [24]

Refitting

Use reverse procedure. Dress signal and power cables away from hot surfaces such as the Zirconia gas sensor module cell housing (figure 6.10[2]).

NOTE
When refitting gas sensor module signal cables to Multiplexer board it is important that they are located in the correct connector (see figure 6.4).

6.17 Multiplexer board fuses

Refer to figure 6.8

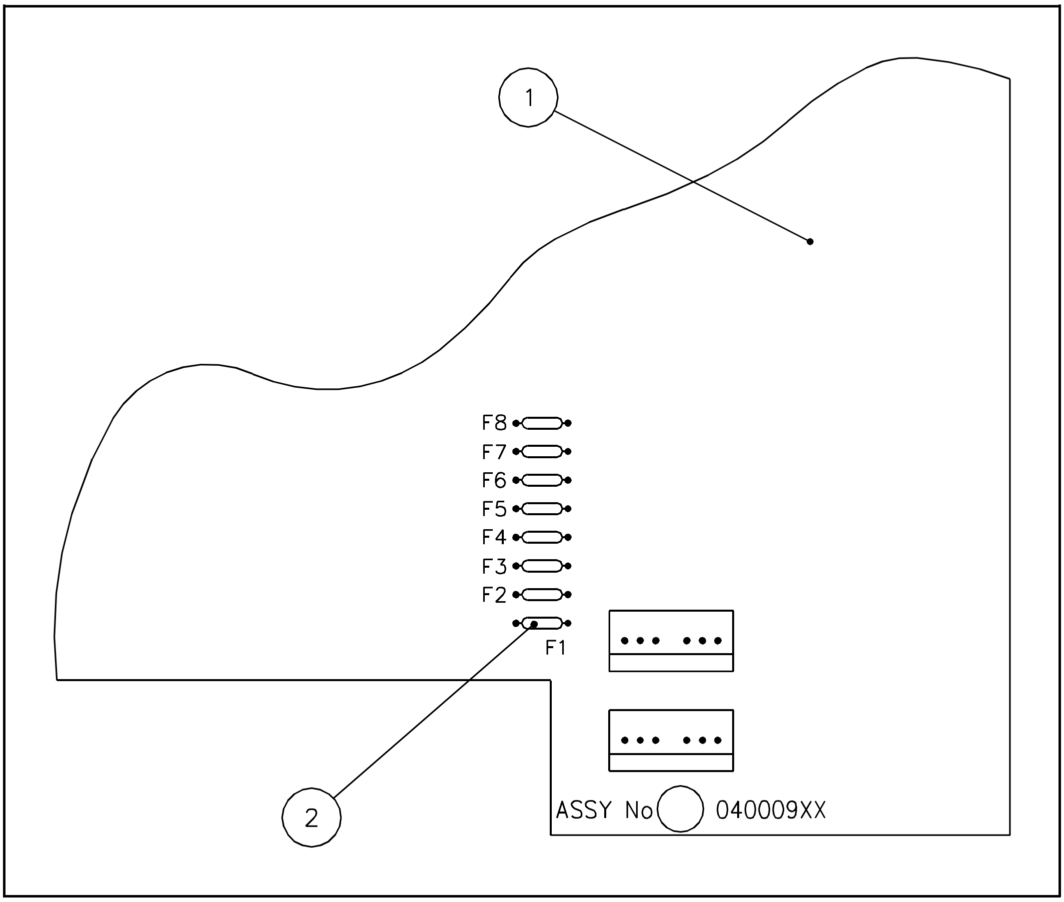

Figure 6.8 Multiplexer board fuses

Removal

a) Remove Multiplexer board (see section 6.16).
b) Determine which fuses [2] are open circuit and replace.

Refitting

Use reverse procedure.

6.18 Terminal board

Refer to figure 6.9

Removal

a) Remove two power connector fixing screws (figure 6.4[8]) and partially withdraw power connector from rear of chassis to allow access to Motherboard connections.
b) Remove Switched mode power supply, Microprocessor board, Sensor interface board and option boards.
c) Disconnect the following from the Mother board: keypad ribbon cable, power connector, solenoid valves, internal fan and external fan.
d) Remove Multiplexer board (see section 6.16).
e) Remove two off rear card frame fixing screws [3]

f) Remove two of PL6 'D' connector hexagonal pillars [2] from rear of chassis
g) Remove Motherboard earth connection from earth stud in rear of chassis [1]
h) Remove two off front card frame fixing nuts [4].
i) Lift front card frame clear of threaded studs in base of chassis [4] and withdraw complete card frame assembly frontwards and remove.
j) Remove the required Terminal board(s) by unplugging from Motherboard and withdrawing through rear card frame.

Refitting

Use reverse procedure.

NOTE

Ensure that customer terminals are engaged in rear of chassis when refitting card frame assembly.

6.19 Mother board

Refer to figure 6.9

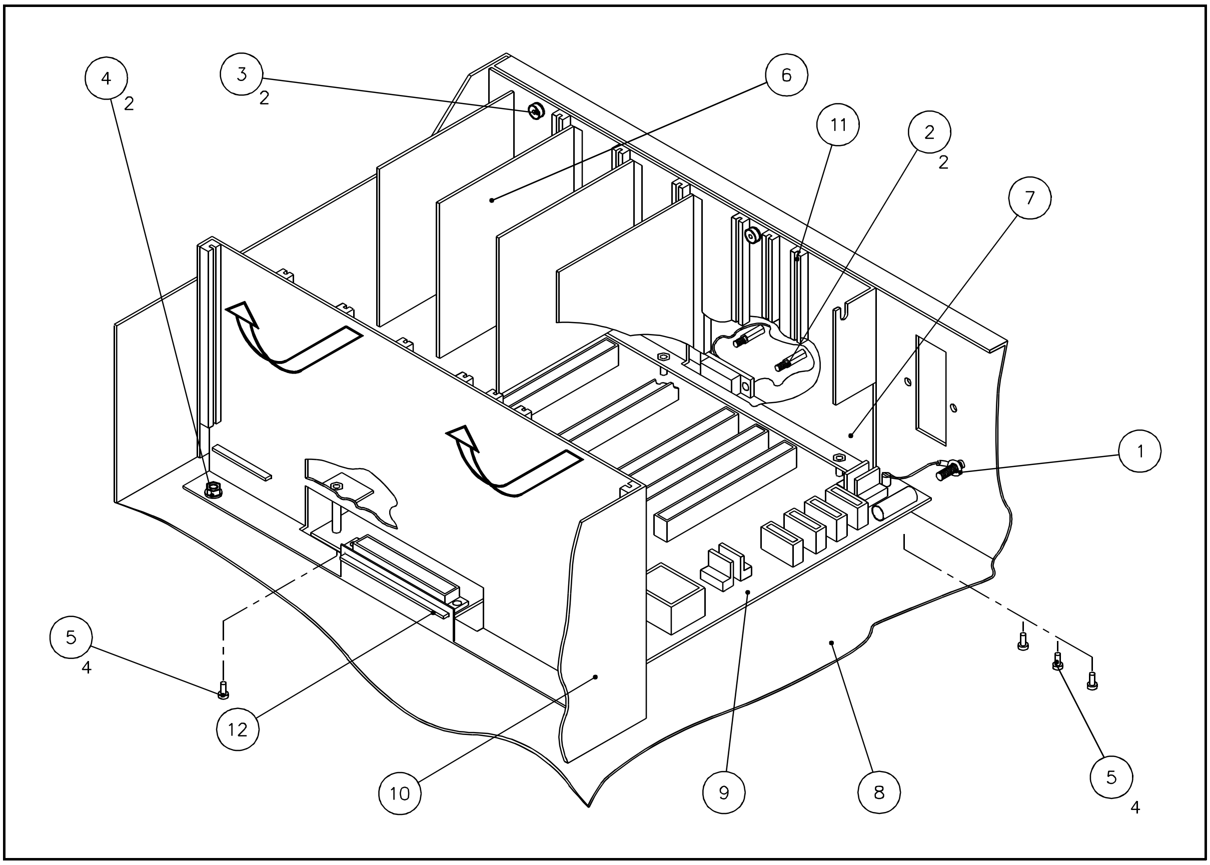

Figure 6.9 Motherboard removal

Removal

a) Remove all terminal boards (see section 6.18).
b) Remove three rear card frame fixing screws and front card frame fixing screw [5]

Refitting

Use reverse procedure.

NOTE
Ensure that the three motherboard tongues [12] are engaged in the front card frame. Ensure that protective earth connections are secure.

6.20 Zirconia gas sensor module

Refer to figure 6.10

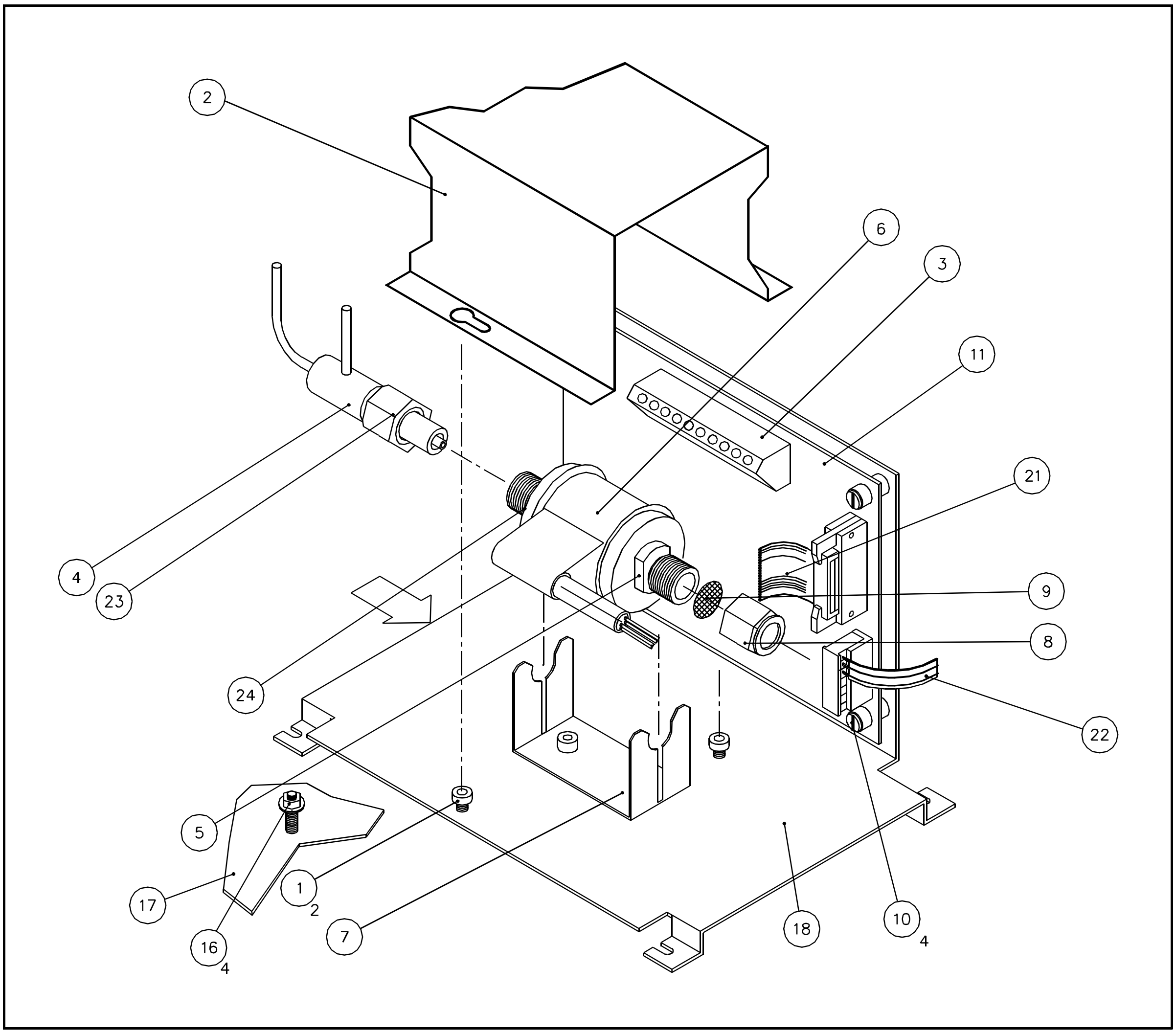

Figure 6.10 Zirconia gas sensor module

> **WARNING**
>
> **The surface of some components within the zirconia gas sensor module assembly are hot. Switch off the electrical power and allow 10 minutes for the zirconia cell to cool before servicing module.**

Removal

a) Remove cover (see section 6.1).
b) Disconnect signal cable [21]
c) Loosen two off Zirconia cell housing [2] fixing screws [1].
d) Slide zirconia cell housing side ways and lift to remove.
e) The zirconia cell [6] has two flats for spanners [5] [24], one at each end.

Anchor zirconia cell using spanner flat [24] and undo nut [23].

> **CAUTION**
>
> **If the zirconia cell is not anchored with the correct spanner flat the cell will be destroyed.**

f) Loosen four off gas sensor module fixing nuts [16].
g) Slide zirconia gas sensor module mounting bracket [18] sideways and lift to remove. Rest zirconia gas sensor module on front card frame.
h) Disconnect power cable [22]

Refitting

Use reverse procedure.

> **NOTE**
>
> **When refitting zirconia cell sample connector nut [23] use zirconia cell spanner flat [24] to anchor zirconia cell [6]. This union must be leak tight. Leaks will cause a high oxygen reading.**

Refer to the QuickStart Manual for calibration instructions.

6.21 Pressure driven zirconia inlet pipework (with restrictor assembly)

Refer to figure 6.11.

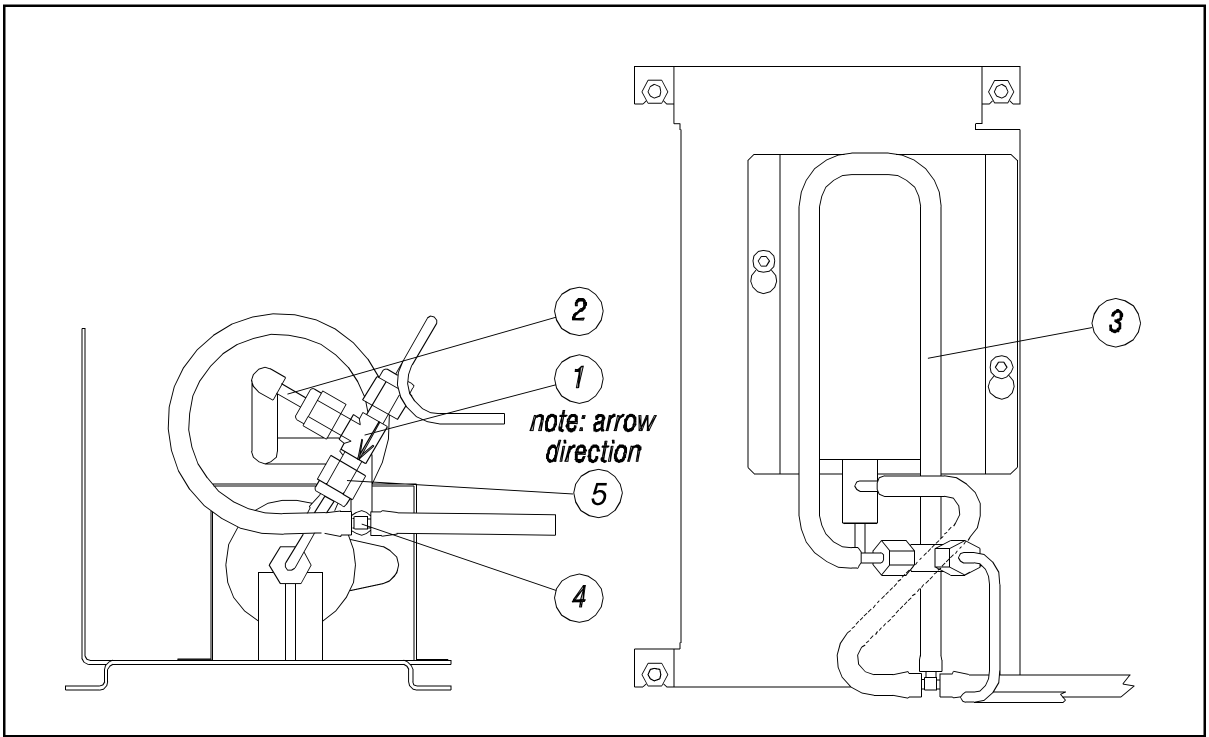

Figure 6.11 Pressure driven zirconia gas sensor module.

> **WARNING**
>
> **The surface of some components within the zirconia gas sensor module assembly are hot. Switch off the electrical power and allow 10 minutes for the zirconia cell to cool before servicing module.**

Removal

a) Slacken the three nuts[5] on the tee piece restrictor assembly[1].
b) Note the direction of the arrow on the restrictor assembly[1].
c) Carefully pull out the sample pipework and remove the restrictor assembly[1].
d) Slacken off the connector at the rear of the chassis & remove the sample inlet pipe.

Refitting

a) Use reverse procedure, ensuring arrow on restrictor assembly[1] is pointing in the direction of the sample flow, as before.

6.22 Flow driven zirconia inlet pipework (without restrictor)

Refer to figure 6.12

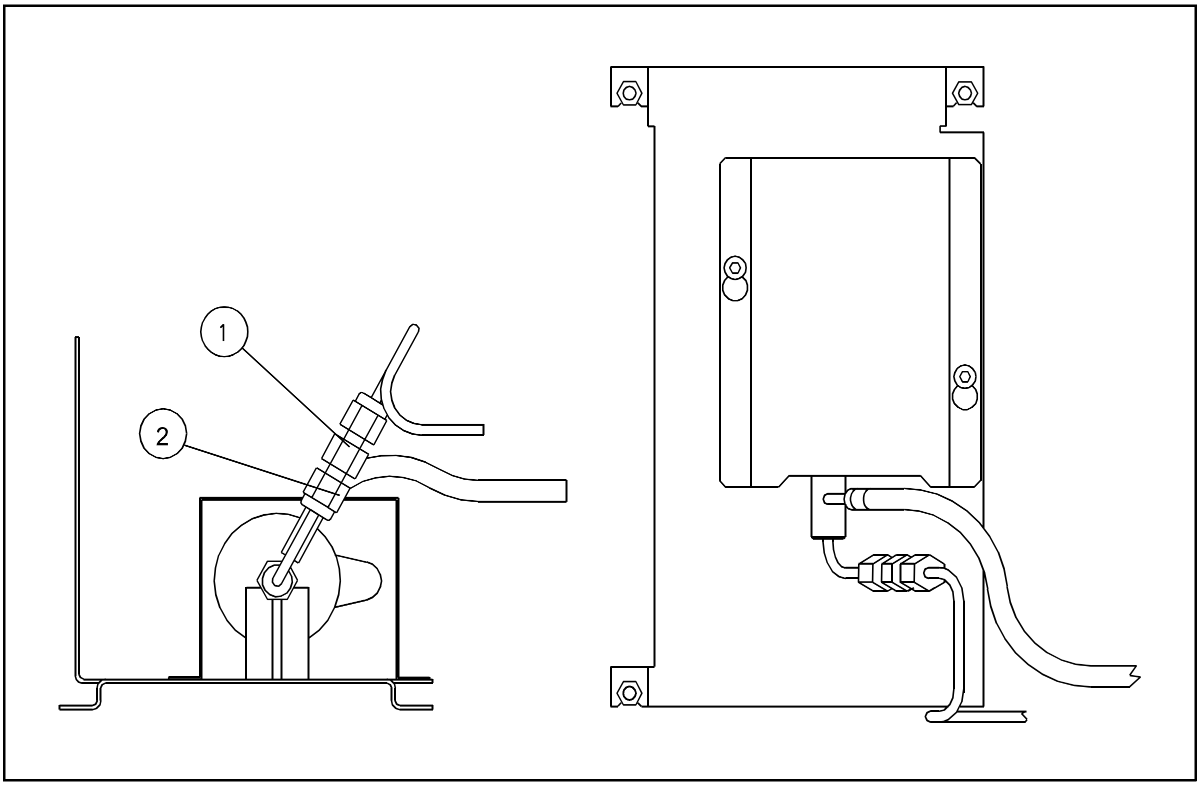

Figure 6.12 Flow driven zirconia gas sensor module

> **NOTE**
>
> **The flow driven system is non restricted, and does not have a bypass. The tee piece restrictor (figure 6.11 [1]) is replaced by a straight connector (figure 6.12 [1]).**

Removal of flow connector

a) Slacken the two nuts[2] on the connector[1].
b) Carefully pull out the sample pipework and remove the connector[1].
c) Slacken off the connector at the rear of the chassis & remove the sample inlet pipe.

Refitting

a) Use reverse procedure.

6.23 Zirconia control board

Removal

Refer to figure 6.13

Note: on newer zirconia sensors, wire colours will be:
Pin 1-yellow
Pin 2 - blue
Pin 4 - green
Pin 5-white
Pin 9-red
Pin10-red

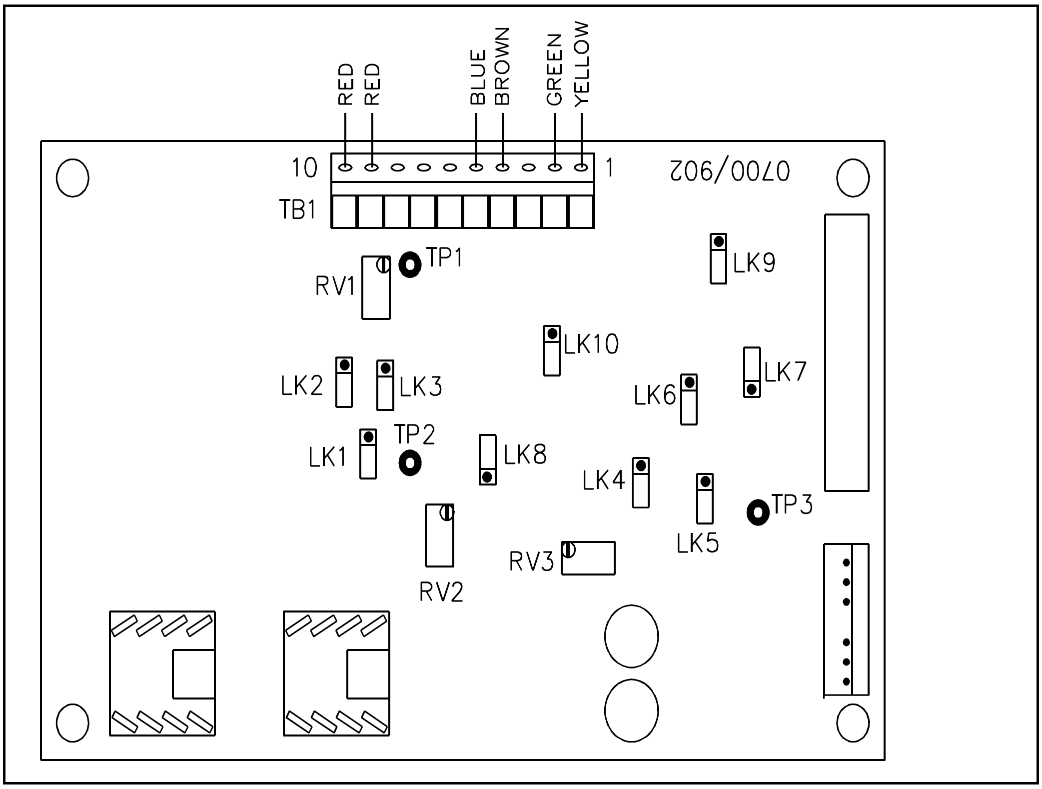

Figure 6.13 Zirconia control board

WARNING
The surface of some components within the zirconia gas sensor module assembly are hot. Switch off the electrical power and allow 10 minutes for the zirconia cell to cool before servicing module.

a) Remove zirconia gas sensor module (see section 6.20).
b) Disconnect wiring from the terminal block TB1 on 00700/902 zirconia control module PCB [3].
c) Undo four off fixings for Zirconia control module PCB [10] by rotating ¼ turn anti-clockwise.
d) Lift zirconia control module PCB from four fixings [10].

Refitting

Use reverse procedure. Connections from the zirconia cell to terminal block TB1

on the 00700/902 zirconia control board are shown in figure 6.13. Set links as per the original board (see table 6.1 for details). The location of the links is shown in figure 6.13.

Table 6.1 Zirconia control board link settings

Link on 00700/902 PCB	Setting for 703 cell	Setting for 704 cell
LK1	LT	LT
LK2	80	00
LK3	40	00
LK4	LZ	LZ
LK5	LZ	LZ
LK6	LB	LB
LK7	UP	UP
LK8	HA	HA
LK9	SR	SR
LK10	LG	LG

After the replacement of this component, the zirconia gas sensor module will need to be set up. See section 6.23.1 below.

6.23.1 Setting up Zirconia Gas Sensor Module

Once the Zirconia Gas Sensor Module has been refitted to the xentra 4100 it must be set up in accordance with the following procedure if either the House Keeping PCB (00700902) or the Zirconia sensor (00703000 or 00704000) has been replaced. For multi-cell analysers, **power up only one sensor at a time.**

Refer to figure 6.13

a) Ensure that the links (LK1 to LK10) on the house keeping PCB are set correctly (see table 6.1). Ensure that RV1 is initially set fully counter clockwise (ccw).

b) Switch the instrument on whilst monitoring the voltage at TP1

(temperature) with respect to TP3 (ground).

The reading should rise steadily, Make the following adjustments quickly. For zirconia sensor 00703000 adjust RV1 (temperature) to obtain a reading of 7465mV ±20mV.
For zirconia sensor 00704000 adjust RV1 (temperature) to obtain a reading of 5898mV ±20mV. **Ensure this voltage is not exceeded.**

c) Use the xentra 4100 display to show the diagnostics for the gas sensor module (MENU, SETUP, DISPLAY, DIAGNOSTICS), and select the CELL TEMP diagnostic for the module.
For zirconia sensor 00703000 adjust RV2 until the displayed temperature is 725 $\pm 1^{O}$C.
For zirconia sensor 00704000 adjust RV2 until the displayed temperature is 575 $\pm 1^{O}$C.

d) **Note** : Gases referred to below should be introduced to the module via the sample inlet connector at 5psig ±3psig for pressure driven systems or 200 to 550 ml/min for flow driven systems.

Introduce clean dry instrument air.

Monitor the voltage at TP2 with respect to TP3; once the reading has stabilised, adjust RV3 to obtain a reading of 106±0.1mV.

e) If available, introduce a nominal 0.3% oxygen in nitrogen gas mixture.

Check that the reading (TP2 wrt TP3) is as specified by the following formula:

Nominal Reading = $106 + (2.3 \times 2.1543 \times 10^{-2} \times 848 \times \ln(20.95/P1))$ mV*

Where P1 is the actual percentage oxygen concentration of the nominal 0.3% oxygen in nitrogen gas mixture.

* Permitted tolerance : +1mV -10mV

If the reading is greater than the maximum permitted value, re-adjust RV1 (temperature) to give the *nominal reading* ±1 mV.

If the reading is below the minimum permitted value, re-adjust RV1 (temperature) to give a reading between 8 and 10mV below the *nominal reading.*

f) Calibrate the zirconia gas sensor module (Refer to QuickStart manual).

6.24 Zirconia cell

Refer to figure 6.10.

WARNING

The surface of some components within the zirconia gas sensor module assembly are hot. Switch off the electrical power and allow 10 minutes for the zirconia cell to cool before servicing module.

a) Remove zirconia gas sensor module (see section 6.20).
b) Disconnect wiring from terminal block TB1 on 00700/902 zirconia control module PCB [3].
c) Loosen two off Zirconia cell housing [2] fixing screws [1].
d) Detach the cell sample connector [4] from the restrictor assembly 'T' (figure 6.11[1]). Detach the viton tube from the vent port on the side of the cell sample connector [4].
e) Slide zirconia cell housing (including check valve assembly if fitted) side ways and lift to remove.
f) The zirconia cell [6] has two flats for spanners [5,24], one at each end. Anchor the zirconia cell using spanner flat [24] and undo nut [23].

CAUTION
If the zirconia cell is not anchored with the correct spanner flat the cell will be destroyed.

g) Anchor the zirconia cell using the other spanner flat [5] and undo the reference side nut [8].
h) Remove nut and gauze from the reference side of the cell [8] and [9] on.
i) Lift Zirconia cell from spring mounting clip [7]

Refitting

Use reverse procedure. When refitting nut [8] use spanner flat [5] on the zirconia cell. Connections to from the zirconia cell to terminal block TB1 on the 00700/902 zirconia control board are shown in figure 6.13.

NOTE
When refitting zirconia cell sample connector nut [23] use zirconia cell spanner flat [24] to anchor the zirconia cell [6]. This union must be leak tight. Leaks will cause a high oxygen reading.

Refer to section 6.23.1 for set up and the QuickStart manual for calibration instructions.

6.25 Purity paramagnetic gas sensor module

Removal

Refer to figure 6.4

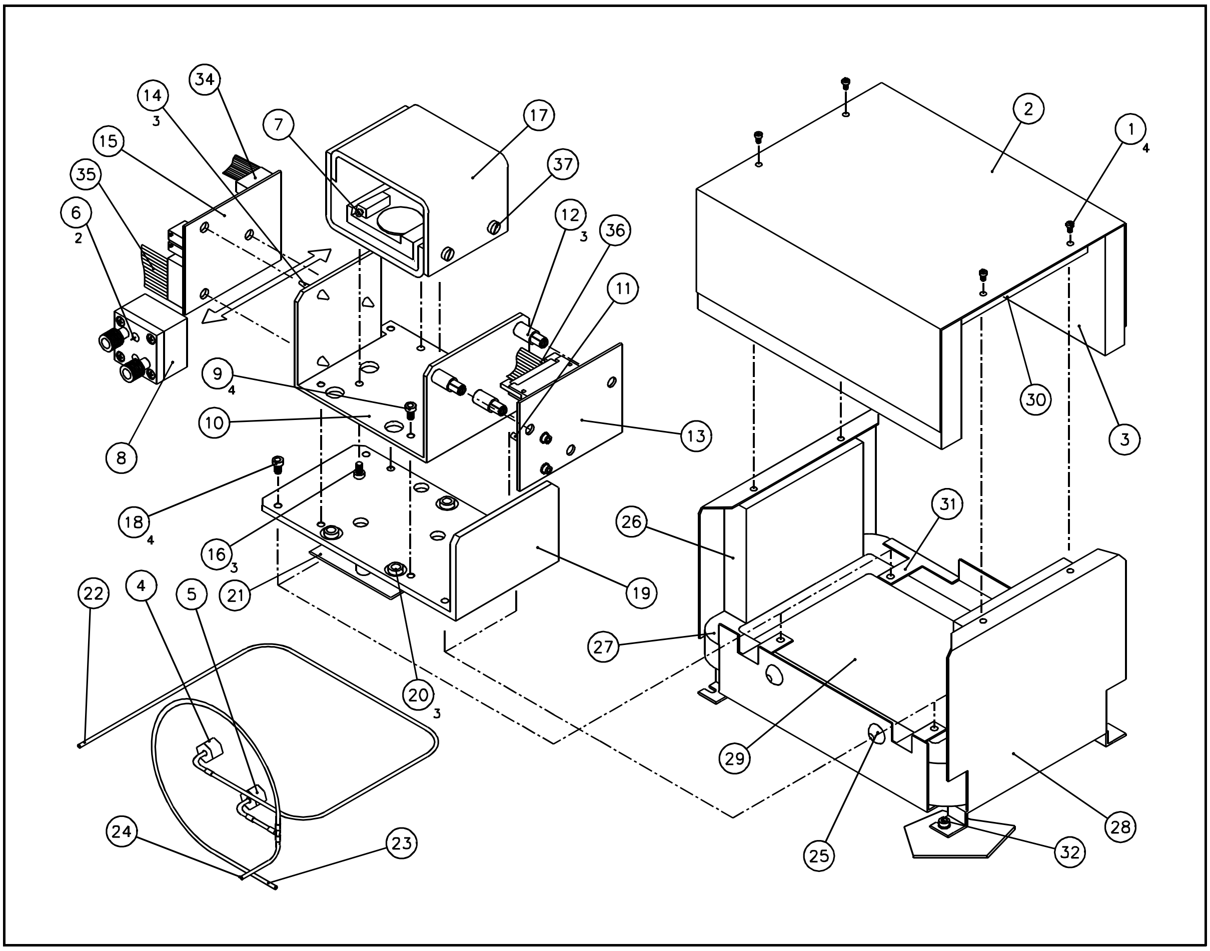

Figure 6.14 Purity paramagnetic gas sensor module

a) Remove cover (see section 6.1).

b) Disconnect gas sensor module signal cable from Multiplexer board connector [23].

c) Disconnect gas sensor module power cable from Multiplexer board connector [24]. Note: It may be necessary to lift the Multiplexer board [1], out of its card guides, to gain access to the power cable connection. All other connections to the Multiplexer board may be left connected during this operation.

Refer to figure 6.14

d) Disconnect sample tubing [22,23] from cell connectors[4,5]. Identify inlet and outlet for ease of re-connection.

e) Remove four off gas sensor module cover fixing screws [1] and remove cover [2].

f) Loosen four off gas sensor module fixing nuts [32]. The gas sensor module oven insulation will need to be displaced (not removed) during access to the fixing nuts.
g) Slide gas sensor module sideways and lift to remove.

Refitting

Use reverse procedure. Refer to QuickStart manual for calibration instructions.

6.26 Purity paramagnetic heater assembly

Refer to figure 6.14.

Removal

a) Remove purity paramagnetic gas sensor module (see section 6.25).
b) Remove oven insulation [30] and two off [3] in one piece.
c) Disconnect gas sensor signal cable [36] from PL1 on 01166/901 PCB [13]
d) Remove four fixing screws [9] for the transducer bracket and remove transducer bracket complete with paramagnetic transducer and associated boards [13,15]. Withdraw sample tubing through grommet [25] as transducer bracket is removed.
e) Remove four heater plate fixing screws [18] and withdraw heater plate a sufficient distance to allow gas sensor module power cable to be disconnected from the temperature control board 04100/901.

Refitting

Use reverse procedure. When refitting gas sensor module power cable to temperature control board ensure that centre core of power cable goes to 04100/901 terminal block TB1 terminal 3. The other two cores of the gas sensor power cable are located one each in terminals 2 and 4.

Refer to the QuickStart manual for calibration instructions

6.27 Purity paramagnetic transducer

Refer to figure 6.14

Note: The 01156A/000 paramagnetic transducer includes the 01156/904 PCB. The temperature compensation is specific to this combination, therefore the PCB supplied with the 01156A/000 must remain paired with it.

CAUTION

The paramagnetic transducer and its cell should not be subjected to mechanical shock which may result in damage to the cell suspension.

Removal

a) Remove paramagnetic gas sensor module (see section 6.25).
b) Remove oven insulation [30] and two off [3] in one piece.
c) Remove sample connections [4,5] from paramagnetic cell [8].
d) Disconnect ribbon cable [35] from PL1 on 01156/904 PCB [15].
e) Disconnect ribbon cable [34] from PL2 on 01156/904 PCB [15].
f) Disconnect gas sensor signal cable [36] from PL1 on 01166/901 PCB [13]
g) Remove four fixing screws [9] for transducer bracket and remove transducer bracket complete with paramagnetic transducer [17] and associated boards [13,15].
h) Remove three off paramagnetic transducer fixing screws [16] from the underside of the transducer bracket [10].
i) The paramagnetic transducer magnet frame [17] may now be removed.
j) Remove the 01156/904 PCB [15] by releasing plastic fasteners.
k) Pair 01156/904 PCB with magnet frame assembly by plugging in 10 way connector from magnet frame assembly to PL2 on 01156/904 PCB [15]

Refitting

Use reverse procedure

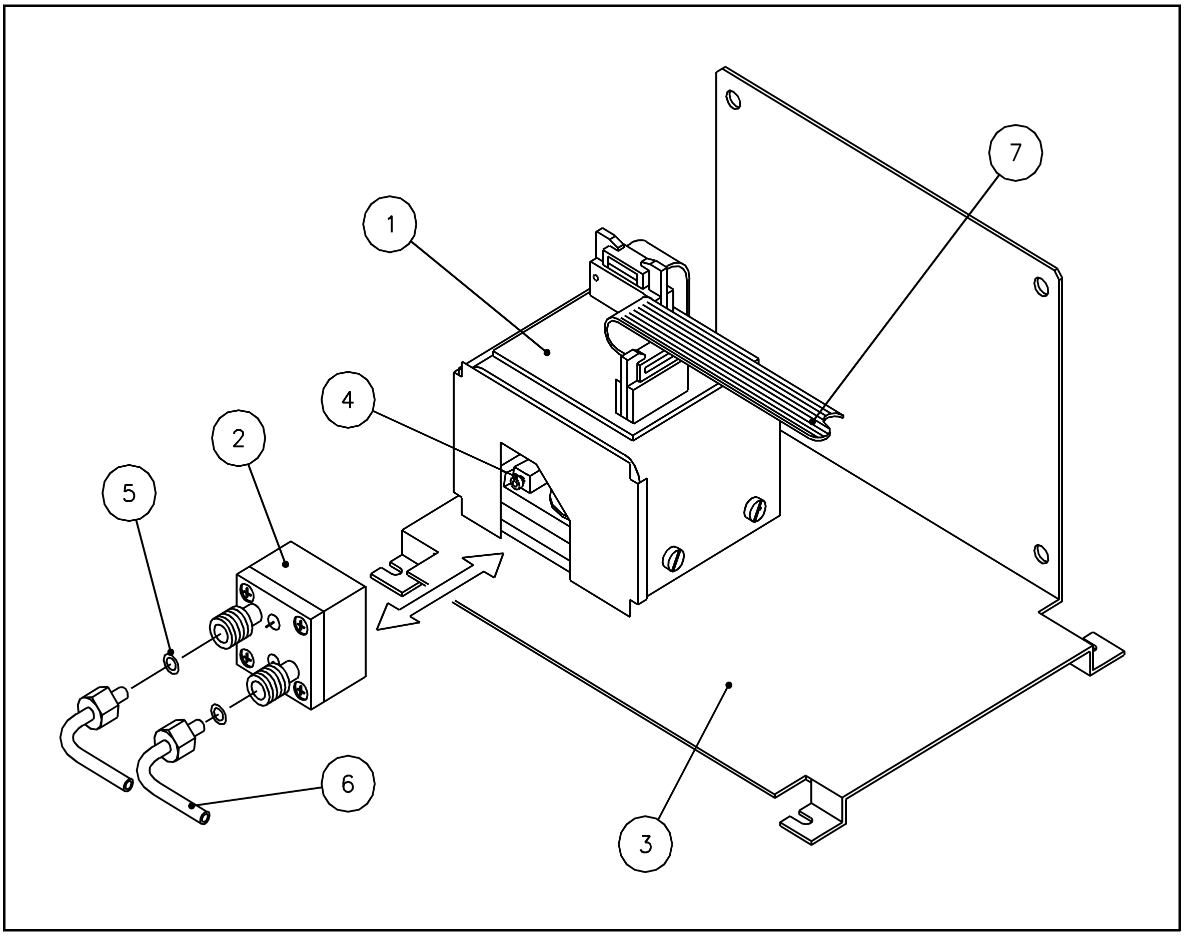

Figure 6.15 Control paramagnetic gas sensor module

6.28 Control paramagnetic gas sensor module

Removal

Refer to figure 6.4

a) Disconnect gas sensor module signal cable from Multiplexer board connector [23].

b) Disconnect gas sensor module power cable from Multiplexer board connector [24]. Note: It may be necessary to lift the Multiplexer board [1], out of its card guides, to gain access to the power cable connection. All other connections to the Multiplexer board may be left connected during this operation.

Refer to figure 6.15

c) Disconnect sample tubing from cell connectors[6]. Identify inlet and outlet for ease of re-connection.

d) Loosen four off gas sensor module fixing nuts.
e) Slide gas sensor module sideways and lift to remove.

Refitting

Use reverse procedure. Refer to QuickStart manual for calibration instructions.

6.29 Control paramagnetic transducer

Refer to figure 6.15

Note: The 01156A/000 paramagnetic transducer includes the 01156/904 PCB. The temperature compensation is specific to this combination, therefore the PCB supplied with the -1156A/000 must remain paired with it.

CAUTION
The paramagnetic transducer and its cell should not be subjected to mechanical shock which may result in damage to the cell suspension.

Removal

a) Remove control paramagnetic gas sensor module (see section 6.28).
c) Remove sample connections [6] from paramagnetic cell [2].
d) Disconnect ribbon cable [7] from PL1 on 01156/904 PCB [1].
f) Remove three off paramagnetic transducer fixing screws from the underside of the module bracket [3].
g) The paramagnetic transducer may now be removed.

Refitting

Use reverse procedure. Refer to QuickStart manual for calibration instructions.

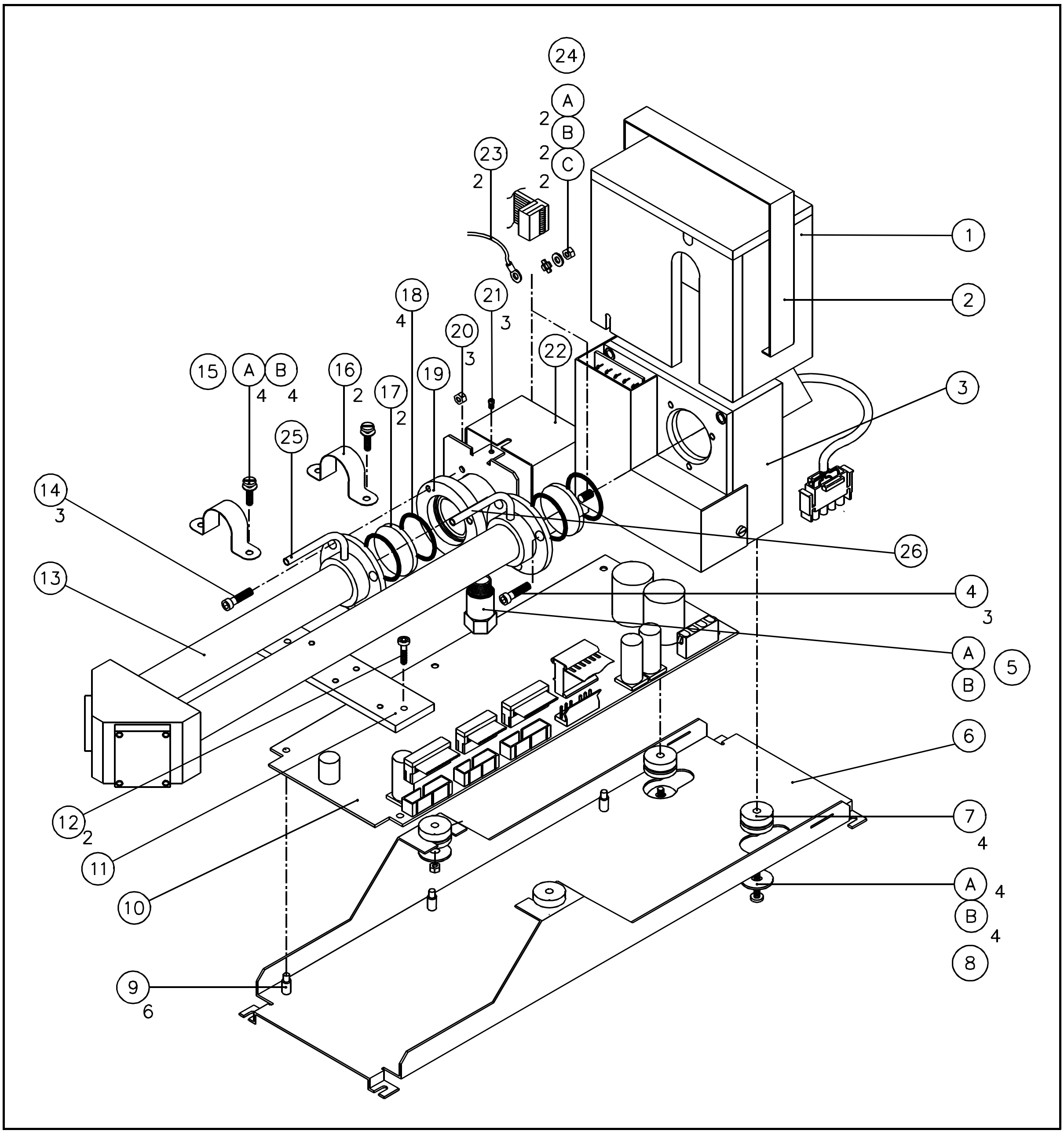

Figure 6.16 1210 High sensitivity Gfx gas sensor assembly

6.30 Gfx gas sensor module assembly

Removal

a) Remove the instrument cover (see section 6.1).
b) Refer to figure 6.20. Remove the auxiliary power connector [10] and the signal connector [11] from the house keeping PCB.
c) Referring to figure 6.16, remove the viton tubing from the transducer inlet [25] and outlet [26] gas connections. Loosen the four transducer washer nut fixings and slide the transducer to the right and lift free from the 4100 chassis.

Refitting

a) Use reverse procedure.

CAUTION

Ensure that the correct signal and power ribbon cables are fitted to the correct sockets on the transducer house keeping PCB before applying power (see figure 6.20).

b) See section 6.41 for the transducer setup and calibration procedure.

6.31 Gfx Source replacement

Refer to figure 6.17.

Removal

a) Remove the transducer from the 4100 chassis (see section 6.30).
b) Remove the three hex cap screws [30] and carefully withdraw the source [31] from the chopper box [3]. Retain the three spacers [32] which will fall away. Remove the source plug from the house keeping PCB by squeezing the sides and easing upwards.

WARNING

Hot surfaces are present on the chopper box [3] and IR source [31].

Refitting

a) To replace the new source first ensure that the 'o' ring [33] is in position in the 'o' ring groove on the source. Insert the three screws [30] into the source body and slide the three spacers [32] onto the screws. Offer up the assembly to the chopper box [3] and push well home. Tighten the screws and insert the plug into the house keeping PCB source socket (see figure 6.20).

b) Replace Chopper Box Scrubber. Install a new scrubber bag [34] by removing hex socket blanking plug [35], withdrawing and discarding the old scrubber. Remove the new scrubber bag from its protective foil bag and insert it into the cavity. Replace the blanking plug and tighten, making sure that the paper scrubber bag is not damaged.

c) Replace the transducer into the 4100 chassis in the same position. (see section 6.30).

d) Setup and calibrate transducer according to the procedure in section 6.41.

CAUTION

The chopper box and light pipe(see figure 6.16 [3,19]) are sealed enclosures. Once opened a new scrubber must be fitted.

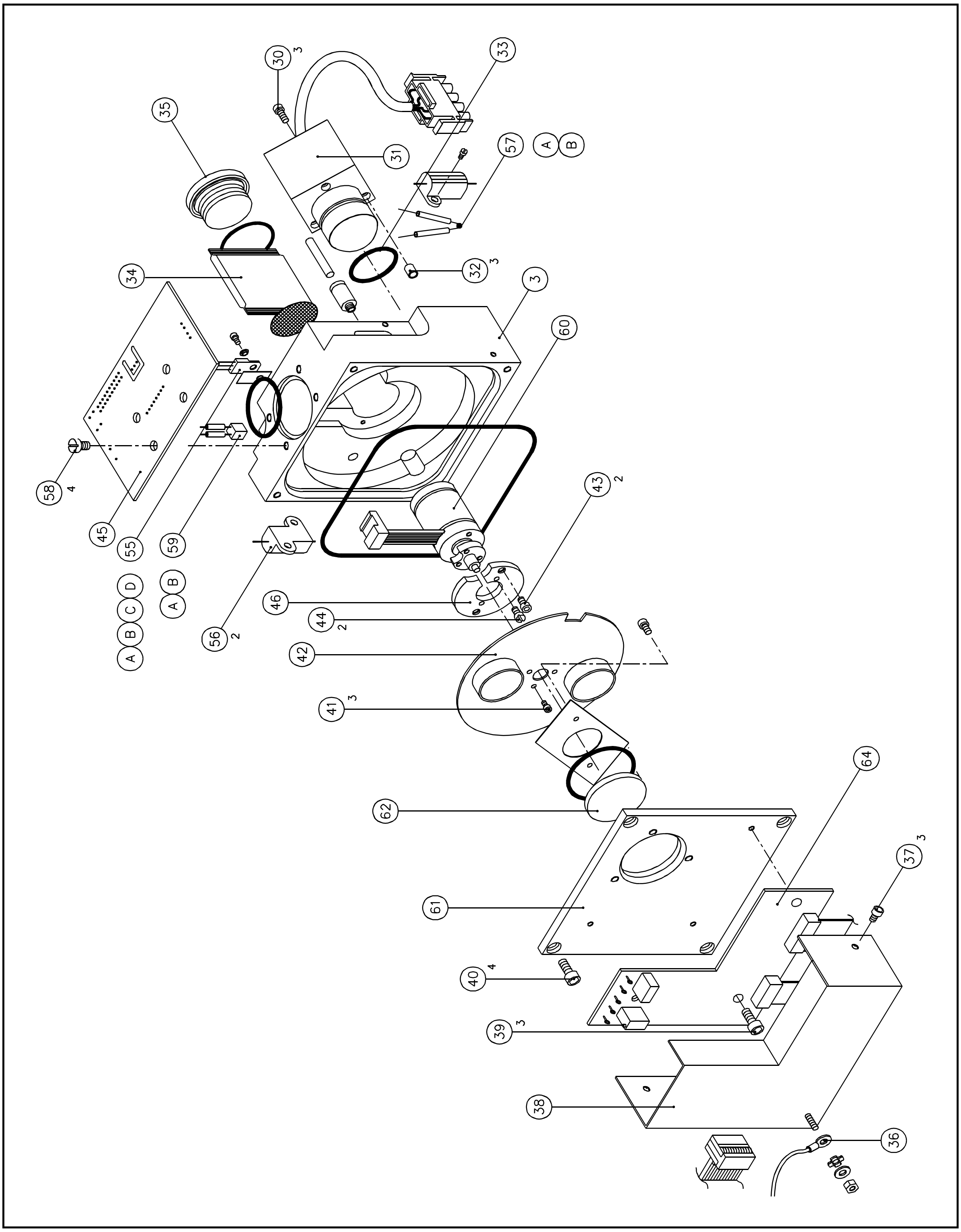

Figure 6.17 Gfx 1210 chopper box assembly

6.32 Gfx chopper motor replacement

Removal

Referring to figure 6.16.

a) Remove the Gfx transducer from the 4100 chassis (see section 6.30).
b) Cell assembly removal. Remove the insulation retaining clip [2] and insulation [1] from the chopper box [3]. Remove the detector ribbon cable and earth wires [23] from the detector box [22].

WARNING

Hot surfaces are present on the chopper box and IR source see figure 6.17 [3,31].

c) Remove the cell assembly by removing screws [15] and cell clamps [16] then remove the three cell flange/chopper box lid fixings [4]. Carefully withdraw the cell assembly and remove the CaF_2 window [17] and 'o' rings [18] from the chopper box lid and cell end.

Refer to figure 6.17.

d) The IR filter[62] is now exposed.

NOTE

Do not touch the IR filter [62] with bare fingers.

e) Chopper wheel removal. Remove the earth wire [36]. Remove the three signal processing PCB shielding box retaining screws [37] and remove the shielding box [38]. Remove the three PCB retaining screws [39] and pull the PCB [64] forward to allow access to the chopper box lid. Remove the four chopper box lid retaining screws [40] and carefully remove the chopper box lid [61].
f) Remove the three chopper wheel retaining screws [41] and carefully remove the chopper wheel [42] by aligning the large slot with the optical pick-up. Do not touch the surfaces of the gas filters with fingers.

CAUTION

The chopper wheel [42] should be treated with care as the gas filters can be broken by rough handling.

g) Chopper motor removal. Remove the two motor mounting fixings [43]

and withdraw the motor [60] forward, easing the motor plug from the PCB [45] connector. Remove the two screws [44] to separate the motor mounting plate [46] from the motor.

Replacement

a) The new motor is installed by reversing the procedure described above. Inspect the 'o' rings and replace where necessary.
b) Install a new chopper box scrubber (see section 6.31(b)).
c) Replace the transducer into the 4100 chassis in the same position (see section 6.30).
d) Setup and calibrate transducer according to section 6.41.

6.33 Gfx chopper wheel replacement

Refer to figure 6.16.

Removal

a) Remove the transducer from the 4100 chassis (see section 6.30).
b) Remove the cell assembly (see section 6.32).
c) Remove the chopper wheel (see section 6.32).

Replacement

a) The new chopper wheel may be installed by reversing the above procedure. Do not touch the surfaces of the gas filters with fingers.

CAUTION

The chopper wheel [42] should be treated with care as the gas filters can be broken by rough handling.

b) Install a new chopper box scrubber (see section 6.31 (b)).
c) Replace the transducer into the 4100 chassis in the same position. (see section 6.30).
d) Setup and calibrate transducer according to section 6.41.

6.34 Gfx mirror cleaning and replacement

Removal

Refer to figure 6.18.

a) Remove the transducer from the 4100 chassis (see section 6.30).
b) Remove the four mirror bezel fixings [47] 1/4 turn at a time to prevent stressing the mirror and carefully remove the bezel [48] without letting the mirror [49] fall out.
c) Clean with a soft tissue. The tissue may be moistened with acetone or an aqueous detergent to help cleaning. If necessary replace the mirror.
d) Inspect the two 'o' rings [50][51] for damage or degradation, replace if necessary.
e) Repeat the above for the other mirror.
f) Whilst the mirrors are off, inspect the inside surface of the cell and clean if necessary (see section 6.35).

Refitting

a) Re-assemble according to figure 6.18 and carefully tighten bezel retaining screws 1/4 turn at a time to avoid stressing the mirror.
b) Replace the transducer into the 4100 chassis in the same position. (see section 6.30).
c) Setup and calibrate according to section 6.41.

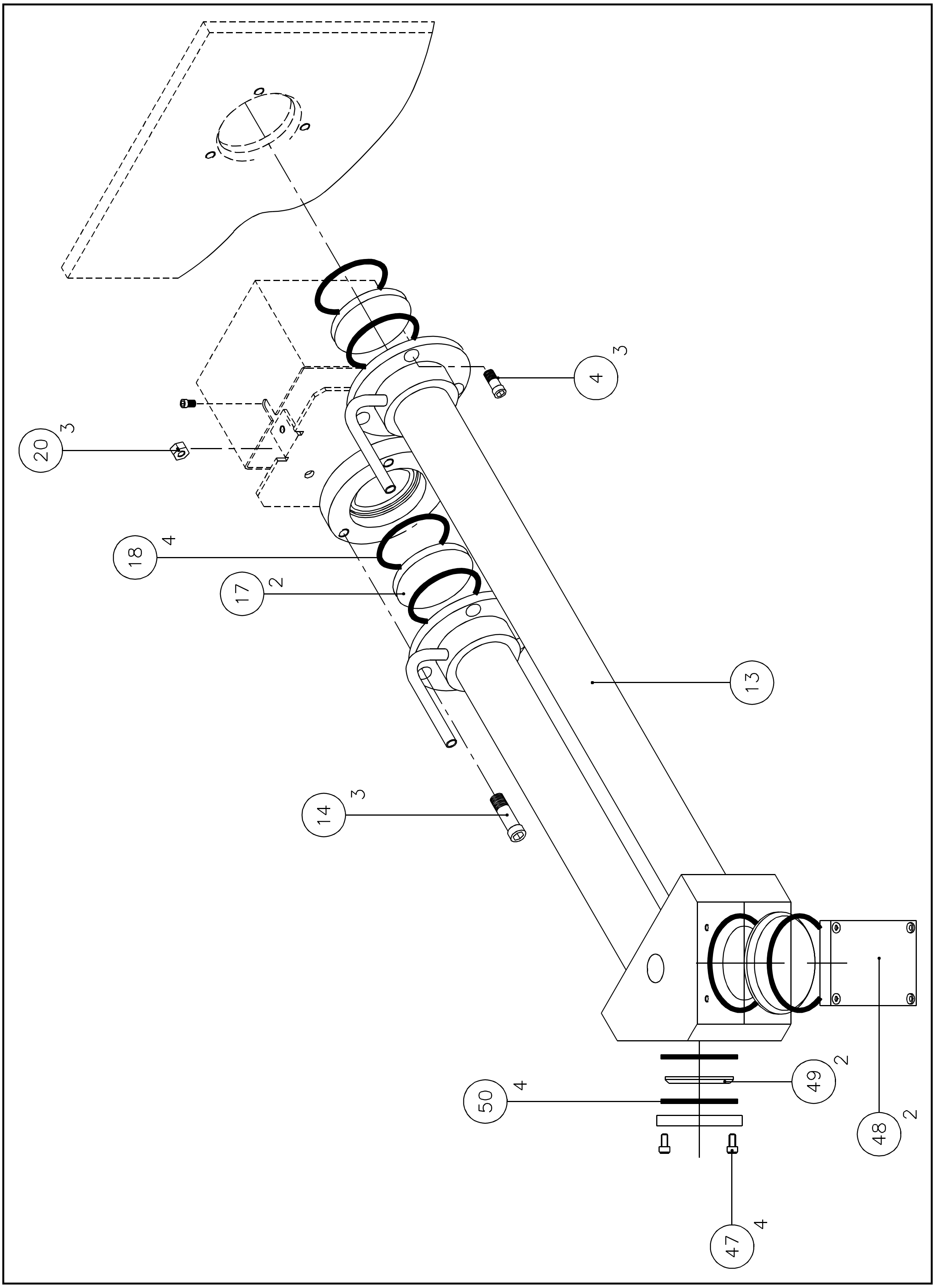

Figure 6.18 High Sensitivity Gfx optical cell assembly

6.35 Gfx optical windows cleaning and replacement

Removal

Refer to figure 6.16.

a) Remove the transducer from the 4100 chassis (see section 6.30).
b) Remove the cell assembly (see section 6.32).
c) Remove the detector scrubber [5] and the detector box [22] by loosening the three fixings [21]. Remove the flange screws [14] which also holds the detector box lid with nuts [20]. Carefully remove the window [17] and 'o' rings [18] from the cell end.
d) Clean the windows with a soft tissue. The tissue may be moistened with acetone or an aqueous detergent may be used to help cleaning. If necessary replace the windows.
e) Whilst the windows are off, inspect the inside surface of the cell and clean if necessary (see section 6.36).

Refitting

a) Inspect the window 'o' rings and replace if necessary. Re-assemble as above in reverse order, using a new detector scrubber.
b) Replace the chopper box scrubber once reassembled (see section 6.31(b)).

> **CAUTION**
>
> **The chopper box [3] and detector light pipe [19] are sealed enclosures. Once opened a new scrubber must be fitted.**

c) Replace the transducer into the 4100 chassis in the same position. (see section 6.30).
d) Setup and calibrate according to section 6.41.

6.36 Gfx cell cleaning and replacement

Refer to figure 6.16.

Removal

a) Remove the transducer from the 4100 chassis (see section 6.30).
b) Remove the cell assembly (see section 6.32).
c) Remove the detector assembly (see section 6.37).
d) Remove the mirrors. (See section 6.34).
e) Clean the inside of the cell tubes using a plug of soft tissue pushed through the cell. The tissue may be moistened with acetone or an

aqueous detergent to help cleaning.

f) Whilst disassembled inspect the windows, mirrors and 'o' rings. Clean or replace as necessary.

Refitting

a) Re-assemble as above in reverse order, using a new detector scrubber.
b) Replace the chopper box scrubber once reassembled (see section 6.31(b)).

CAUTION
The chopper box [3] and detector light pipe [19] are sealed enclosures. Once opened a new scrubber must be fitted.

c) Replace the transducer into the 4100 chassis in the same position. (see section 6.30).
d) Setup and calibrate according to section 6.41.

6.37 Gfx detector PCB assembly

Removal

Refer to figure 6.16.

a) Remove the transducer from the 4100 chassis (see section 6.30).
b) Remove the insulation retaining clip [2] and insulation [1] from the chopper box. Remove the detector ribbon connector and earth wires [23] from the detector box [22].
c) Remove the detector scrubber [5] and the detector box [22] by loosening the three fixings [21]. Move the cell assembly away from the chopper box by removing the three screws [4] and loosening the four cell clamp screws [15].

Refer to figure 6.19.

d) Loosen the three PCB fixing screws [52] and carefully withdraw the PCB assembly [63], taking care not to allow the spacers [53] to fall.

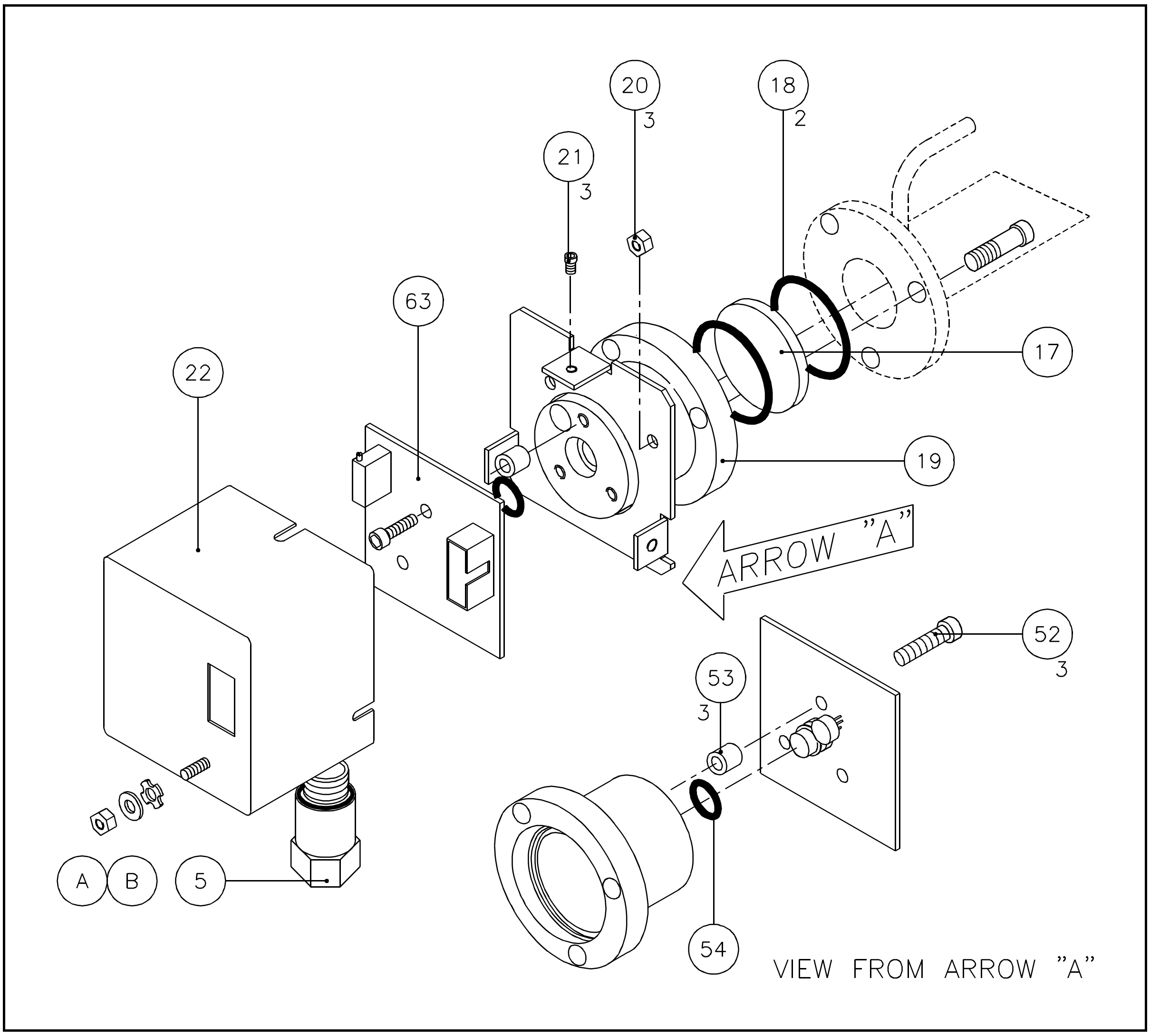

Figure 6.19 1210 Gfx detector assembly

Refitting

a) Remove the screws and spacers from the old PCB and assemble same onto the new PCB. Ensure that the 'o' ring [54] is in position inside the light pipe [19].

b) Holding the screw heads in place with three fingers, offer the assembly up to the light pipe [19] in the correct orientation and push home. Complete the re-assembly as above in the reverse order.

c) Fit a new detector scrubber.

d) Fit a new chopper box scrubber if the cell assembly was moved (see section 6.31(b)).

CAUTION

The detector light pipe [19] is a sealed enclosure. Once opened a new scrubber must be fitted.

e) Replace the transducer into the 4100 chassis in the same position. (see section 6.30).
f) Setup and calibrate according to section 6.41.

6.38 Gfx chopper box PCB assembly

Removal

Refer to figure 6.17.

a) Remove the transducer from the 4100 chassis (see section 6.30).
b) Remove the cell assembly (see 6.32).
c) Remove the chopper wheel (see 6.32).
d) Remove the power transistor fixing screw [55]. Unsolder the two heater [56] and the thermistor [57] connections on the chopper box PCB [45]. Remove the four PCB fixings [58] and carefully raise the PCB whilst holding the chopper motor plug from beneath to prevent straining the wires. Lift the PCB free from the chopper box. It will still be connected via the transition cable to the house keeping PCB.

Refer to figure 6.16.

e) Now remove the chopper box [3] from the base plate [6] by releasing the two anti vibration mount fixings [8] and sliding forward and up. Remove the connectors from the house keeping PCB [10] and release the six PCB fixings [9]. Remove the PCB from the base plate and ease away the chopper motor PCB and cable.

Refitting

a) Reassemble the transducer using the new PCB as above, in reverse order. Layout the cables beneath the house keeping PCB to aid re-assembly.

Refer to figure 6.17.

b) The new thermal fuse [59] and lead insulators should be fixed to the PCB before assembly.

c) The power transistor [55] is supplied loose and should be fixed to the chopper box using the correct assembly of the insulating kit before soldering the leads to the PCB.

CAUTION

Ensure that the correct cables are fitted to the correct sockets before applying power (see figure 6.20).

d) Replace the chopper box scrubber (see section 6.31(b)).
e) Replace the transducer into the 4100 chassis in the same position (see section 6.30).
f) Setup and calibrate according to section 6.41.

6.39 Gfx house keeping PCB assembly

Removal

Refer to figure 6.16.

a) Remove the transducer from the 4100 chassis (see section 6.30).
b) Remove the two cell anti-vibration fixings and mounts [12].
c) Remove all connecting cables and leads from the PCB.
d) Unlock the six PCB fixings [9] and ease the PCB upwards. Slide it away from the chopper box raising the cell assembly if necessary until free of the transducer.

Refitting

a) Reassemble as above in the reverse order.

CAUTION

Ensure that the correct cables are fitted to the correct sockets before applying power (see figure 6.20).

b) Replace the transducer into the 4100 chassis in the same position. (see section 6.30).
c) Setup transducer according to section 6.41.
d) If a new house keeping PCB has been installed then the calibration data for the transducer must be transferred from the 4100 microprocessor PCB to the transducer. Switch on the 4100, enter the SUPERCAL menu (see section 7) and perform a transducer data UPLOAD to copy the calibration data onto the on-board EEPROM.
e) Calibrate according to section 6.41.

6.40 Gfx signal processing PCB assembly

Removal

Refer to figure 6.16?

a) Remove the transducer from the 4100 chassis (see section 6.30).
b) Remove the cell assembly (see section 6.32).
c) Remove the two cell anti-vibration fixings and mounts [12]. Remove all connecting cables and leads from the house keeping PCB.
d) Unlock the six house keeping PCB fixings [9] and ease the PCB upwards. Slide the PCB away from the chopper box raising the cell assembly if necessary until free of the transducer.
e) Release the cables from the transducer chassis [6].

Refer to figure 6.17.

f) Remove the earth wire [36]. Remove the three signal processing PCB shielding box retaining screws [37] and remove the shielding box [38]. Remove the three PCB retaining screws [39] and lift out the PCB and cables.

Refitting

a) Check that the correct value of the gain resistor R14 is in position on the new PCB. Table 6.2 lists the correct resistor size and Servomex part number.

Table 6.2 Gfx gain resistor sizes

Version	R14
1210/701 (CO)	470R (2624-0655)
1210/731 (CO_2)	1k5 (2624-0770)
1210/741 (N_2O)	1k3 (2623-0762)
1210/751 (CH_4)	1k5 (2624-0770)

b) Reassemble as above in the reverse order.
c) Replace the transducer into the 4100 chassis in the same position. (see section 6.30)

CAUTION

Ensure that the correct cables are fitted to the correct sockets before applying power (see figure 6.20).

d) Setup and calibrate according to section 6.41.

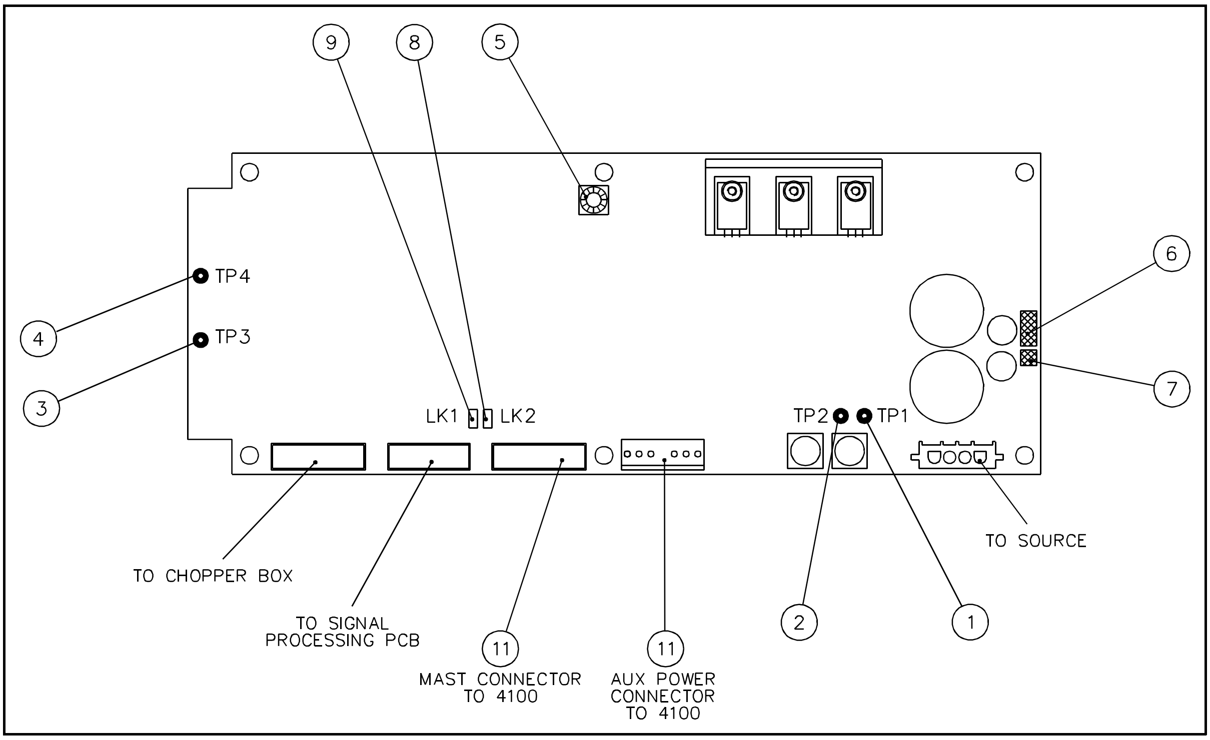

Figure 6.20 Gfx 1210 House keeping PCB assembly

6.41 Gfx set up and calibration

Refer to figure 6.20.

Ensure LK1 and LK2 (items 8,9) on the house keeping PCB 1210/903 are configured for the correct transducer site location. The latter is determined by the plug position on the multiplexer PCB 4000/924 ([1] in figure 6.4) to which the transducer is connected. The links settings for the appropriate transducer site are given in table 6.3.

Table 6.3 Gfx site location link settings		
Plug on Multiplexer PCB	**LK1**	**LK2**
TX1	A	A
TX2	B	A
TX3	A	B
TX4	B	B

Adjust the infrared source voltage by setting SW1 (item 5) on 1210/903 to position 5 (2.0v).

CAUTION

Ensure that the correct source voltage is set before operation. A higher voltage setting will reduce source lifetime.

Switch on the power to the 4100. Check that Power OK LED (D15) on the house keeping PCB (1210/903) is lit.

Preliminary Checks

Source operation check

a) Check the voltage across the outer two pins of PL1 is 1.98v to 2.02v.

b) Check that Source OK LED (D11) on the house keeping PCB (1210/903) is lit.

Chopper motor operation check

c) Check that Motor OK LED (D13) on the house keeping PCB (1210/903) is lit.

Signal processing operation check

d) Check that the Bench OK LED (D16) on the house keeping PCB (1210/903) is lit.

e) Remove the chopper box insulation. Connect a scope to TP1 (wrt TP5) on the signal processing PCB (1210/902). The trace should be stable and look like the trace shown in figure 6.21.

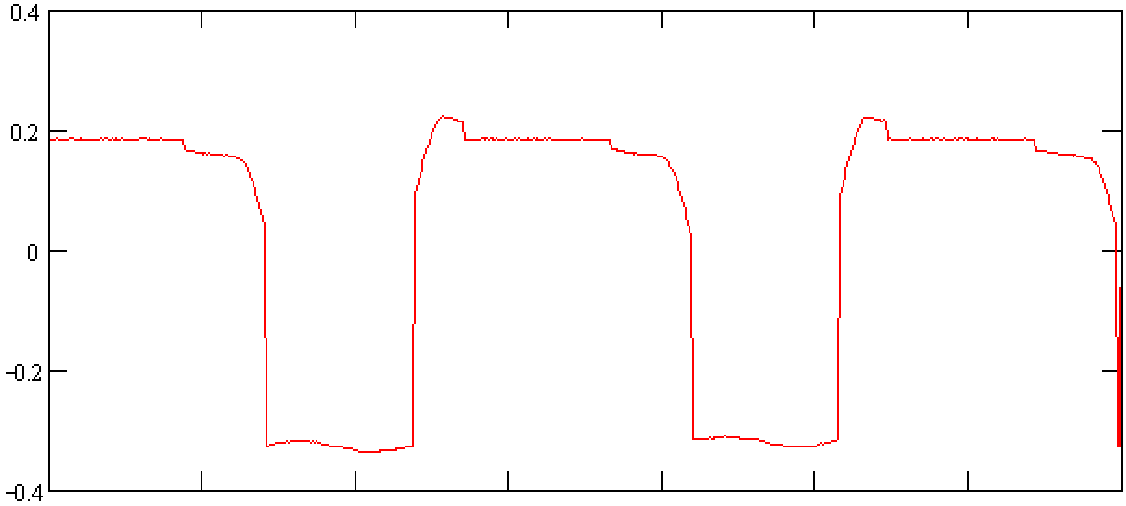

Figure 6.21 Typical Gfx signal trace.

Signal level adjustments

Detector Signal

a) Connect a DVM -ve lead to TP5 (0VA) on the signal processing PCB (1210/902). Connect the DVM +ve lead to TP3 (V_{N2}) and adjust RV1 on the detector pre-amp PCB (1210/901) until the DVM reading is 1.0v +/- 0.05v.

V_{diff} and V_{gas}

b) Connect the DVM +ve lead to TP2 (V_{diff}) and adjust SW1 and RV1 on the signal processing PCB (1210/902) until the DVM reading is 0.0v +/- 0.01v.

c) Connect the DVM +ve lead to TP4 (V_{gas}) and check that the DVM reading is equal to the reading at TP3 +/- 0.1v.

Chopper box temperature check

d) Allow the transducer to stabilize (30min minimum).

e) Measure the chopper box temperature with a thermocouple inserted beneath the insulation, this should be 65°C to 75°C.

Calibration

> **NOTE**
>
> **If a new chopper wheel or a new IR filter has been installed it will be necessary to return the transducer to the factory for linearisation.**

a) Connect the analyser output to a suitable chart recorder.
b) Connect N_2 to the instrument at a flow rate of 1.0 l/min.
c) Monitor the output and ensure that it is stable ($\leq$1vpm/hour) before proceeding.
d) Perform a manual zero calibration setting the target concentration to 0vpm and accept the reading when stable.

e) Connect the span gas to the instrument at a flow rate of 1.0 l/min. Perform a manual span calibration setting the correct target concentration and accept the reading when stable.

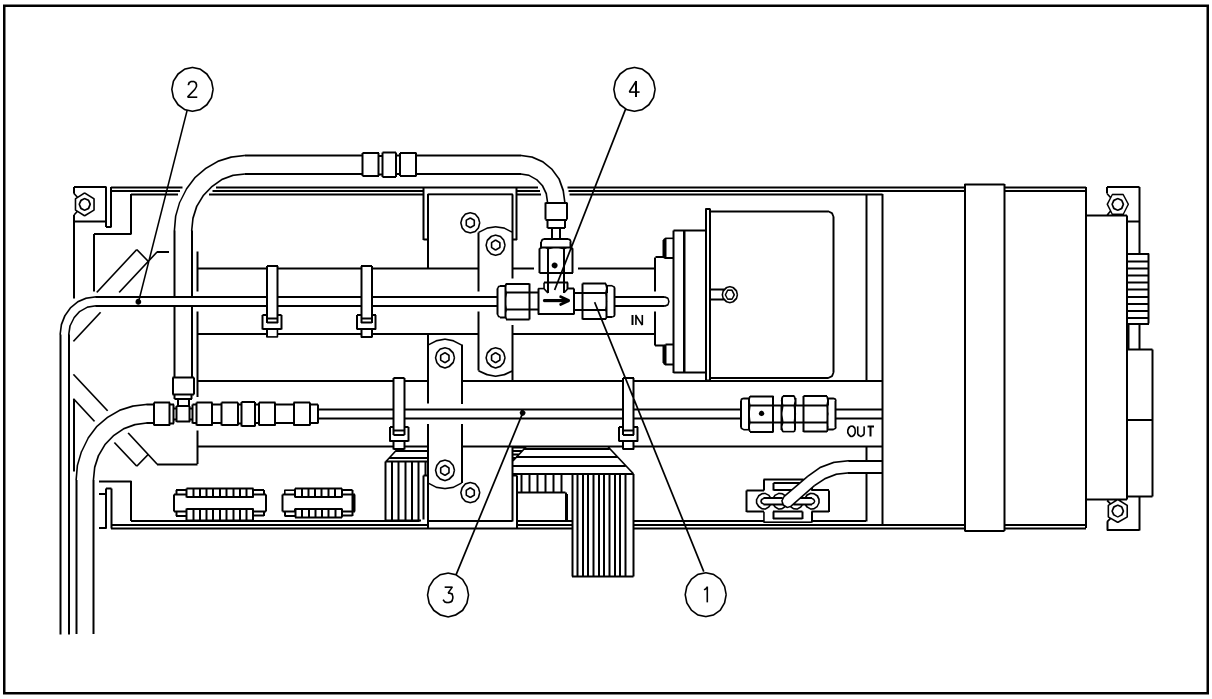

Figure 6.22 Gfx pressure driven sample system.

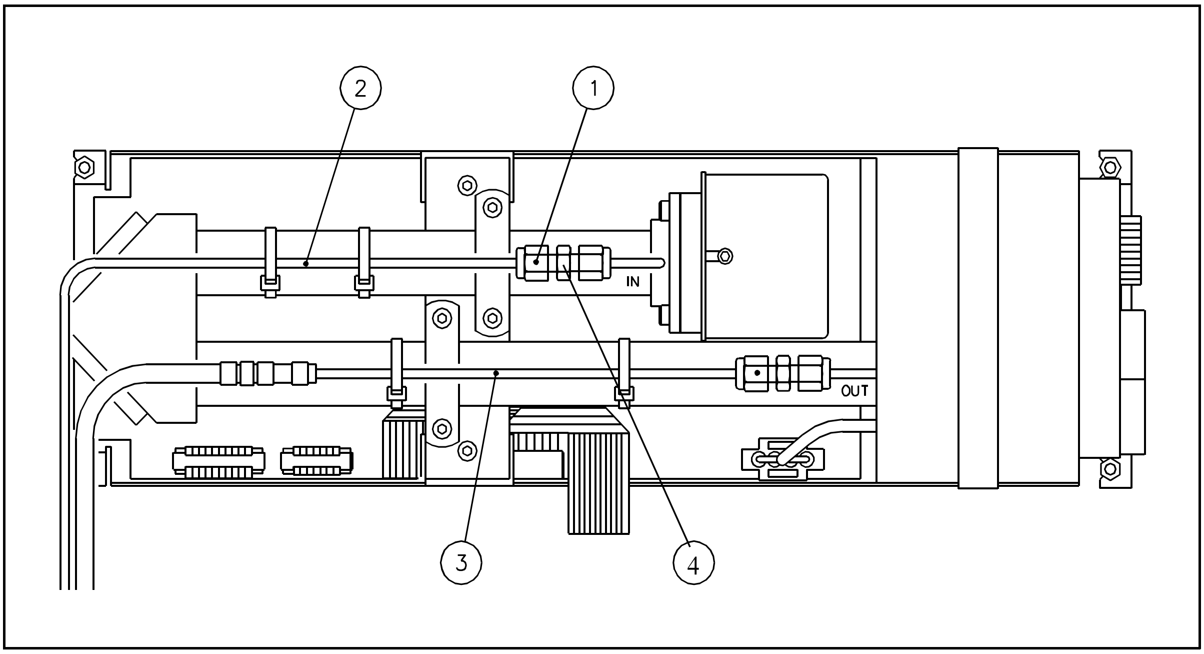

Figure 6.23 Flow driven Gfx sample pipework

6.42 Pressure driven Gfx sample pipework

a) Slacken off three nuts[1] on T piece restrictor, assembly[4].
b) Note direction of ➜ on restrictor assembly[4]
c) Carefully pull out the sample pipework and remove the restrictor assembly[4].
d) Slacken off the connector at the rear of the chassis & remove the sample inlet pipe[2].
e) Follow the same method for the outlet pipe which is connected via a straight union connector.

Refitting

a) Use reverse procedure, ensuring arrow on restrictor assembly[4] is pointing in the direction of the sample flow, as before.

6.43 Flow driven Gfx sample pipework

a) Slacken off two nuts[1] on connector[4].
b) Carefully pull out the sample pipework and remove the connector[4].
c) Slacken off the connector at the rear of the chassis & remove the sample inlet pipe[2].
d) Follow the same method for the outlet pipe.

Refitting

a) Use reverse procedure.

SECTION 7: SOFTWARE MAINTENANCE

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7 SOFTWARE MAINTENANCE

7.1 Software upgrade installation

CAUTION
The microprocessor board is a static sensitive device. Failure to implement good standard anti-static practices could result in damage.

This section details instructions for performing a software update on an instrument. The kit supplied to perform the upgrade will consist of two off EPROM's labelled 04000/6*xx*/*yy*A and 04000/6*xx*/*yy*B. It is not normally necessary to replace the EEPROM (figure 7.1 [8]). If the EEPROM should require replacement then this will be supplied as part of the upgrade kit.

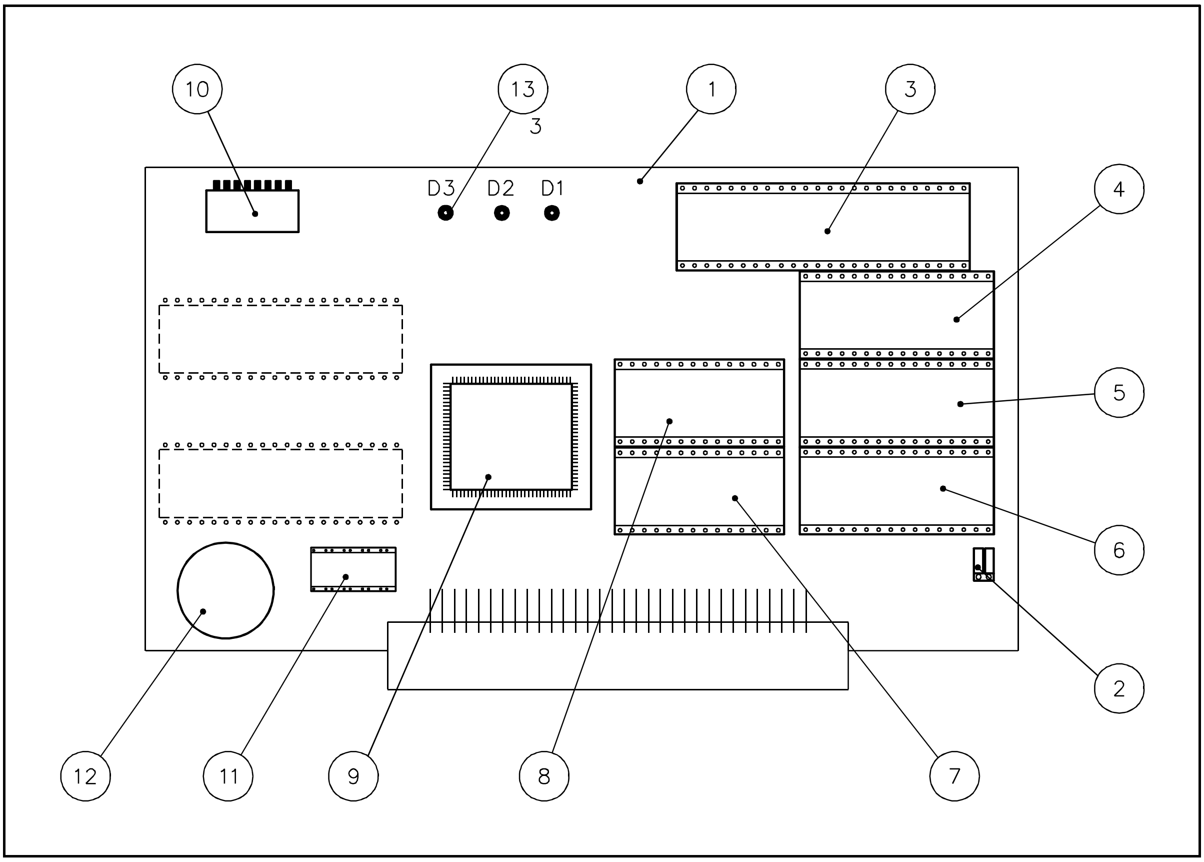

Figure 7.1 Microprocessor board

Procedure

Refer to figure 7.1.

a) Remove microprocessor board from instrument chassis using the procedure defined in section 6.15 of this manual.

b) Using an IC removal tool or similar suitable device remove the two EPROM'S from the PCB [4,5].

c) Insert the two new EPROM's into the PCB. The EPROM labelled 'A' should be fitted in position [4]. The EPROM labelled 'B' should be fitted in position [5].

d) If a new EEPROM has been supplied as part of the upgrade kit then the existing EEPROM [8] should be removed and replaced in a similar manner. It may be necessary to fit the EEPROM before installing the EPROM's [4,5] to ease installation.

e) Check all IC's installed to ensure that none of the pins has been bent during fitting.

f) Replace processor board using the procedure in section 6.15 of this manual. Do not replace the instrument cover at this stage.

g) Power up the system and observe the LED's [13]. All the red LED's should be extinguished in sequence within 4 seconds of powering on. If LED D3 remains on then either the IC's are swapped (installed within the wrong sockets) or some of the IC pins may not be seated correctly. If the IC's are seated correctly and the LED D3 is still illuminated on power on then the IC's may have suffered static damage during fitting.

h) If all the red LED's are extinguished then replace the instrument cover in accordance with section 6.1 of this manual.

i) Under some circumstances additional instructions may be provided with the upgrade kit defining data modifications required through the user interface. This would normally be the case if a new EEPROM [8] has been supplied as part of the upgrade. If these instructions are provided then these should be executed now.

j) The upgrade is now complete.

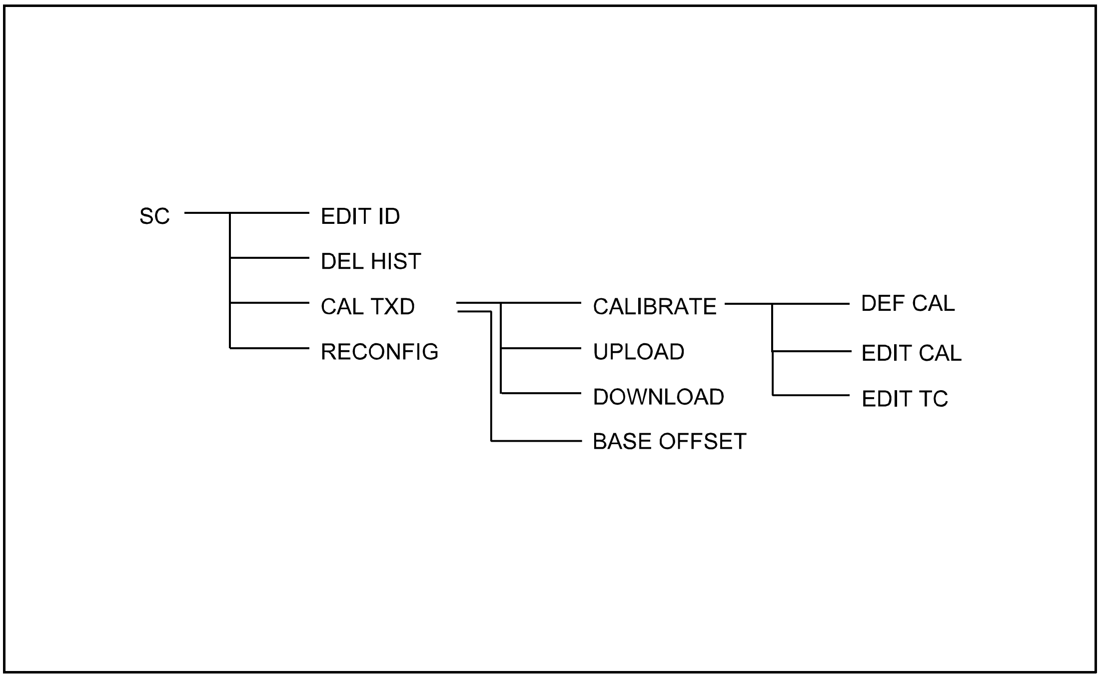

Figure 7.2 Instrument Configuration Menu Map

7.2 Software configuration menu

The QuickStart manual contains comprehensive instructions on all user functions available on the instrument. A separate, hidden, menu is available for use only by trained service personnel. This menu gives access to higher instrument configuration functions. Access to this level of instrument configuration should not be made available to users in normal operation.

7.2.1 Access to the special configuration menu

Access to the special configuration menu is via two security screens:-

a) An encrypted sequence of keys are pressed to indicate to the instrument that access is required to the special configuration menu as follows :

Ensure that the instrument is showing the measure display, if not the press ‘MEASURE’
The following sequence of 7 keys must be pressed in order within 10 seconds to access the second security screen (b).

☞ ▼,ENTER, QUIT,►,MEASURE,▲,MENU

b) The system will then prompt for a special password before giving the user access to the menu. The appearance of the password screen and its operation is exactly the same to that used in normal password operation. The password for this level is ‘1812'.

When the password has been successfully entered the standard instrument menu will be displayed with an additional field labelled "SC".

CALIBRATE/SETUP ALARMS/FAULTS/**<u>SC</u>**

After any function is performed under the Special configuration menu, the user must return to this menu level. Pressing ‘MENU’ again will remove the ‘SC’ option from the menu, thus preventing any unauthorised access.

The special configuration menu is entered by selecting the SC option. The following menu will then be displayed.

EDIT ID/DEL HIST CAL TXD/RECONFIG

The functions of the menu entries are as follows:-

7.2.2 EDIT ID

This enables the user to change the serial number and order number of the instrument. This should only be performed during factory calibration or if the EEPROM [8] or the microprocessor PCB [1] containing a new EEPROM is changed. In these cases the displays should be returned to their original values.

7.2.3 DEL HIST

This deletes the contents of **<u>all</u>** the history buffers on the instrument. This includes faults, alarms, and calibration histories. This should only be performed during factory calibration.

7.2.4 CAL TXD

This option is only required on the xentra 4100 if a Gfx transducer is fitted, and either the EEPROM [8] or the microprocessor PCB [1] containing a new EEPROM is changed.

7.2.5 RECONFIGURE

> **NOTE**
>
> **This totally reformats the configuration of the instrument. On selection of this option, all calibration and configuration information will be deleted.**

On selection of this option the software will ask twice that the user confirms his intention totally to erase the current system configuration. When selected the screen will go blank for some seconds before the following message is displayed.

"INCOMPATIBLE DATA FORMAT
CONTACT LOCAL SERVOMEX SERVICE"

If a new EEPROM or a new microprocessor PCB with a new EEPROM is fitted then this message will also be displayed, and the instrument will have to be re-configured as follows:

The appearance of this message is entirely normal as there is no longer any useable data stored in the EEPROM. To re-activate the instrument the system will need to be re-configured by re-entering the special configuration menu by re-entering the encrypted key sequence (section 7.2.1), the special password (7.2.1b) is not required for this operation.

The system will then prompt the user for an "S-number" with which to effect configuration. The S-number of the system is an alphanumeric code (24 characters in all) that defines the explicit configuration. This is detailed in the 4100 Technical Data Sheet (Available from your local Servomex company, representative or agent). The original S-number for each instrument is recorded on the software configuration label on the base of the instrument.

The important entries necessary to configure the software are given in figure 7.3. None of the entries other than those referenced in figure 7.3 have any effect on software configuration and are only present as a record of the instrument configuration.

When the S-number has been entered the system will briefly respond "INITIALISATION IN PROGRESS" before dropping into the normal start-up sequence.

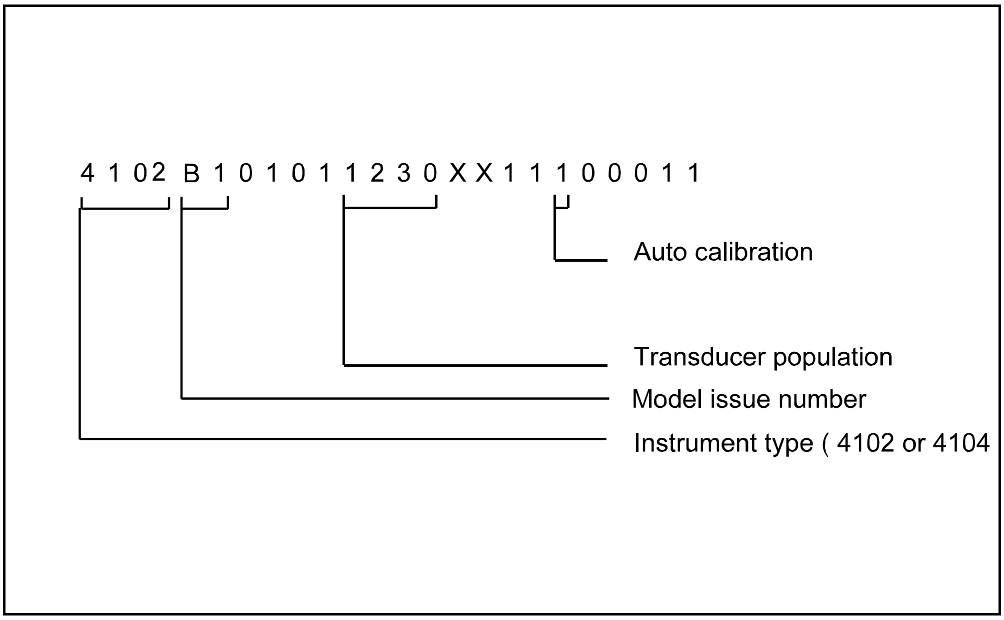

Figure 7.3 S Number Configuration Format

7.3 Definitive Calibration of Gfx

The menu structure which is accessed when Gfx is chosen from the SELECT OBJECT list under CAL TXD appears in figure 7.2. All these functions are associated with definitive calibration, the purpose of which is to define the relationship between IR absorption and gas concentration. This relationship is used for linearisation of the Gfx output and is mathematically derived from a set of experimental data points. The importance of these data to the correct functioning of the instrument cannot be overestimated so extreme care should be exercised when performing any of the activities described below.

Experimental calibration data is specific to a particular Gfx bench and is therefore stored in the circuitry associated with the individual units. The following functions are provided to transfer data between Gfx benches and the computer in the Xentra chassis:

7.3.1 UPLOAD

This transfers data from the chassis to all the Gfx benches connected to it. Uploading should only be necessary where the calibration data has been changed and then only when the integrity of this data is assured.

7.3.2 DOWNLOAD

This transfers data from all the connected Gfx benches to the Xentra chassis. It is necessary to perform a download operation when a replacement Gfx bench or a new EEPROM (figure 7.1 [8]) or a new microprocessor PCB (figure 7.1 [1]) containing a new EEPROM has been fitted to ensure that the instrument is operating with a correct calibration.

If, at the end of either operation, an error message appears to the effect that upload or download has failed then check the configuration of the links on the Gfx transducer house keeping PCB (see section 6.41).

A default set of definitive calibration data is loaded by the reconfiguration procedure (7.2) but this does not guarantee that the instrument will perform within specification. However, once a successful download has been performed correct operation is guaranteed.

7.3.3 DEF CAL

It should never be necessary to use the DEF CAL function in the field except in the most extreme cases of total data loss.

This procedure replaces any existing calibration data with a new set of experimental points. It stores the absorption values corresponding to the stated concentration of a set of test gases which must be supplied to the instrument in turn. Prompts are issued for each pair of values in the order zero, span, intermediate points. Apart from zero (low) and span (high) the order of entry is immaterial but there must be a minimum of three different intermediate points. Note that immediately the first point is entered all pre-existing data are destroyed.

7.3.4 EDIT CAL

It should never be necessary to use the EDIT CAL function in the field except in the most extreme cases of total data loss.

A simple editor is provided which enables the concentration or absorption co-ordinates of a pre-existing data set to be modified. It does not allow insertion or deletion of points. The editor can be used to display the data by stepping through it with the ENTER key. Providing nothing is changed, re-calculation of the linearisation function will not take place.

7.3.5 EDIT TC

It is also possible to edit the coefficients of the temperature compensation function for the Gfx bench. There are four such coefficients which provide a linear and a square term correction for sample temperature to both the zero offset and span. The editor can be used to display the data by stepping through it with the ENTER key.

7.4 Recording the Base Offset of External Inputs

The purpose of "super calibrating" external inputs is to remove any baseline offset due to tolerances in the input circuitry. This need only be done if the 04000/924 board or the EEPROM on the microprocessor board (figure 7.1, [8]) is replaced.

Before recording the base offset it is necessary to disconnect any external inputs from PL5/1,2,3,4 which should be left floating. The corresponding digital status inputs (PL5/9,10 and 7,8) must be shorted out to ensure that the input channels are being read.

Select which of the channels is to be calibrated from the super calibration list. The screen will show

```
E1 BASE OFFSET
167760  OK? Y/N
```

The number on the display is simply the digitised reading from a floating input and should lie in the range 146,000 - 189,000. If this is not the case and nothing is connected to the input terminals the 04000/924 board is faulty. When ENTERed the value is stored and used as a zero offset in subsequent scaling calculations.

SECTION 8: ENGINEERING DRAWINGS

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8 ENGINEERING DRAWINGS

The following electronic circuit drawings are attached as part of this service manual.

Drawing No.	Description	Size	No. Sheets
Instrument Chassis			
02000/102	Microprocessor PCB circuit diagram	A1	1
02000/106A	Dual mA, Dual relay PCB circuit diagram	A3	3
02000/124	Sensor interface PCB circuit diagram	A3	3
04000/101	Motherboard PCB circuit diagram	A1	1
04000/103	Keypad PCB circuit diagram	A2	1
04000/104	Terminal output PCB circuit diagram	A3	1
04000/107	Autocal relay PCB circuit diagram	A3	1
04000/124	Multiplexer PCB circuit diagram	A1	1
Paramagnetic Modules			
01156/103	Paramagnetic house keeping PCB.	A4	1
01156/104	Paramagnetic transducer terminal PCB	A4	1
01166101	Paramagnetic transducer pressure transducer PCB circuit diagram	A3	1
04100101	Oven temperature control PCB circuit diagram	A3	1
Gfx Modules			
01210/101	I.R. Detector pre amplifier circuit diagram - (01210/701 CO transducer only)	A4	1
01210/101A	I.R. Detector pre amplifier circuit diagram - (01210/731 CO_2 , 01210/741 N_2O and 01210/751 CH_4 transducers)	A4	1
01210/102	Signal processing PCB circuit diagram	A3	1
01210/103	Housekeeping PCB circuit diagram	A1	1
01210/104	1210 motor PCB circuit diagram	A4	1
Zirconia Modules			
00700/102	Zirconia transducer housekeeping circuit diagram	A2	2

NOTES